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MONTANA SITING INVENTORY AND POLICY DEVELOPMENT

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AND
POLICY DEVELOPMENT

Montana Energy Advisory Council

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I. INTRODUCTION

The following report has been prepared for the Montana Energy Advisory Council in partial response to the directive of the 1975 Legislature that "the siting of certain energy conversion facilities shall be suspended . . . until a long-term, comprehensive state energy conversion policy and plan" has been prepared. Recognizing the need for a sound framework of policy and information to guide future siting activities in the state, the Legislature specifically called for "a statewide siting inventory and a proposed siting policy for the coordinated siting of energy conversion facilities to meet Montana's energy needs".

The responsibility for these tasks was assigned to the Montana Energy Advisory Council with a further directive from the Governor to conduct a broad assessment of the energy-related data situation in Montana.

Montana's existing involvement in energy facility siting is defined through the provisions of the Montana Major Facility Siting Act. The following section of this report presents a discussion of significant sections of the act and the administrative activities employed by the Energy Planning Division of the Department of Natural Resources and Conservation in interpreting the act and processing specific energy facility applications. This discussion is followed by an analysis and comments on the strengths and weaknesses of the Montana siting process which have emerged during its three and one-half year existence.

At present, the state is not directly involved in energy facility siting until an application is filed under the siting act for a specific facility at a specific location. A major objective of this report has been the investigation of alternative options open to the state in developing a statewide siting policy and inventory to guide the activities of the state and future energy facility applicants in the earliest possible stages of planning to meet energy needs. A statewide siting inventory can be expected to supply a classification system defining the relative compatibility or incompatibility of geographic areas of the state with future siting activities. The third section of the report is a survey of the siting processes employed in six other states which, in varying ways, have taken steps to develop comprehensive policies and statewide studies to fill the needs outlined above. The States of Oregon, Washington, North Dakota, Minnesota, Maryland and California are included in this survey.

A siting inventory and future site selection activities must be guided by the state's policies concerning economic growth, environmental protection, and the types of development activities deemed most appropriate to meet the state's future needs and societal goals. These policies must be reflected by specific siting criteria which define the relative importance of various types of land

uses and natural and cultural environmental characteristics in terms of future energy facility siting. The fourth section of the report discusses some of the policy decisions and organizational activities which will be required in developing siting criteria.

The next two sections of the report discuss the availability of resource data to meet the needs of a siting inventory and the availability of automated systems to facilitate the storage and analysis of data in meeting a variety of resource planning needs. The identification of data needs and subsequent coordination of management efforts to meet those needs is a central topic of the discussion.

Siting decisions have been, and will continue to be, made amid conflicting political pressures and concerns. The State of Montana is presently faced with an important opportunity and a challenge to create a strong policy to guide the future development of its resources and the siting of energy facilities within its borders. National energy concerns and the increased activities of industrial and energy-related interests in the western states have created a critical and immediate need for a state siting policy. Although development of siting criteria and a statewide siting inventory will not eliminate future political pressures, these decision-making tools will help provide a definitive process and framework of information to guide the planning activities and future interactions of all concerned parties in siting-related matters. The concluding section of this report contains recommendations which outline specific proposals designed to meet the policy and planning needs identified in the preceding sections.

II. MONTANA ENERGY FACILITY SITING

The State of Montana has been involved in energy facility siting since passage of the Montana Utility Siting Act in March of 1973 (Section 70-801, et seq., R.C.M. 1947). At that time, the Legislature found that the construction of additional energy conversion facilities might be necessary to meet the increasing need for electricity and other forms of energy, but that these facilities "have an effect on the environment, an impact on population concentration and an effect on the welfare of the citizens of this state" (Section 70-802, R.C.M. 1947). The act was passed to ensure that the location, construction and operation of these facilities will produce minimal adverse effects. Responsibility for administration of the act was given to the Department of Natural Resources and Conservation (Department) which subsequently created the Energy Planning Division (EPD) to carry out the assignment. In the past three and one-half years, the siting act has been applied to the Colstrip Units 3 and 4 application and to applications for a number of transmission lines of varying voltages and lengths. EPD is also presently conducting baseline environmental studies relating to the proposed Burlington Northern coal-based industrial facility involving the possible production of fertilizer, methanol fuel and diesel fuel near Circle, Montana. The following discussion of the Montana siting situation will be presented in three subsections, including: (1) a discussion of several significant provisions of the siting act; (2) a discussion of the administration of the act; and (3) an analysis of the siting process thus far utilized in the state. The latter subsection will be partially comprised of comments and observations collected from participants to the Colstrip Units 3 and 4 application and hearings.

A. Major Facility Siting Act

The siting act was amended and retitled the Major Facility Siting Act in 1975. It states that no energy facility (as defined by the act) may be constructed in this state without a certificate of environmental compatibility and public need. The act established the informational requirements which the state shall use in evaluating and subsequently approving, denying or approving and modifying a facility application. However, the specific process to be used in analyzing the information and applying it to decision-making requirements is not clearly specified in the act. Therefore, this process has been developed through administrative interpretation. Full responsibility for certification of a facility is given to the Board of Natural Resources and Conservation, excepting air and water quality related matters, which reside with the Board of Health and Environmental Sciences. All other siting-related permits or approvals required by other regional, state and local governmental agencies are superceded. The Board of Natural Resources and Conservation is required to determine the basis of need for a proposed facility as well as determine that the facility represents the minimum adverse environmental

impact. Additionally, the benefits to the applicant and the state, the effects of economic activity resulting from the facility, the effects on public health, welfare and safety, and "any other factors" considered relevant must be evaluated (Section 70-810, R.C.M. 1947).

Among other requirements, an applicant must identify alternative facility design technologies and sites and explain the reasons the preferred design and site is considered superior to any reasonable alternative. This explanation must include social, economic, engineering and environmental factors.

As amended in 1975, the siting act provides a maximum period of two years after a major facility or transmission line application is filed for the Department to complete all necessary studies and submit formal recommendations to the Board (some types of transmission line applications must be evaluated within one year). The Department and the Board are guided by an extensive list of environmental, social and economic concerns which must be considered in the evaluation of an application. The Board is required to hold a public hearing on an application under the Montana Administrative Procedure Act not more than 120 days after receiving the Department's final recommendations and issue a decision within 90 days after the close of the hearing. (It should be noted that there is no time limitation on the length of the hearing.) During this proceeding, the applicant must carry the burden of proving that the application should be granted and that all requirements have been met.

The siting act requires annual submission of long-range plans by utilities and any person contemplating construction of a facility within the ensuing ten years. These plans must include the general location and design of all facilities planned for the ten-year period as well as a complete explanation of the demand projections used to determine the need for future facilities. This information is made available to the public and all affected state agencies as well as citizen environmental protection and resource planning groups. For any facilities planned within five years of the submission of the long-range plan, the Department is required to evaluate the proposed site to determine whether construction of the facility would unduly impair the various environmental values cited in the act (Section 70-815, R.C.M. 1947). At this time, no future facility sites have been evaluated under this provision, but the process presumably would provide the opportunity for negotiation and discussion between the state and a potential applicant. The process also would reveal major areas of agreement and disagreement regarding a proposed site, and thus would allow time for constructive modifications of the proposal before the application is filed.

The siting act also features an enforcement provision which states that anyone who violates any portion of the act in the construction or operation of a facility or knowingly submits false information in any report or application required by the act is liable to a civil penalty of not more than $10,000 per violation. Each day of continuing offense constitutes a separate violation. Authorization is also provided for the Department to seek injunctive or other appropriate relief against a violation (Section 70-821, R.C.M. 1947).

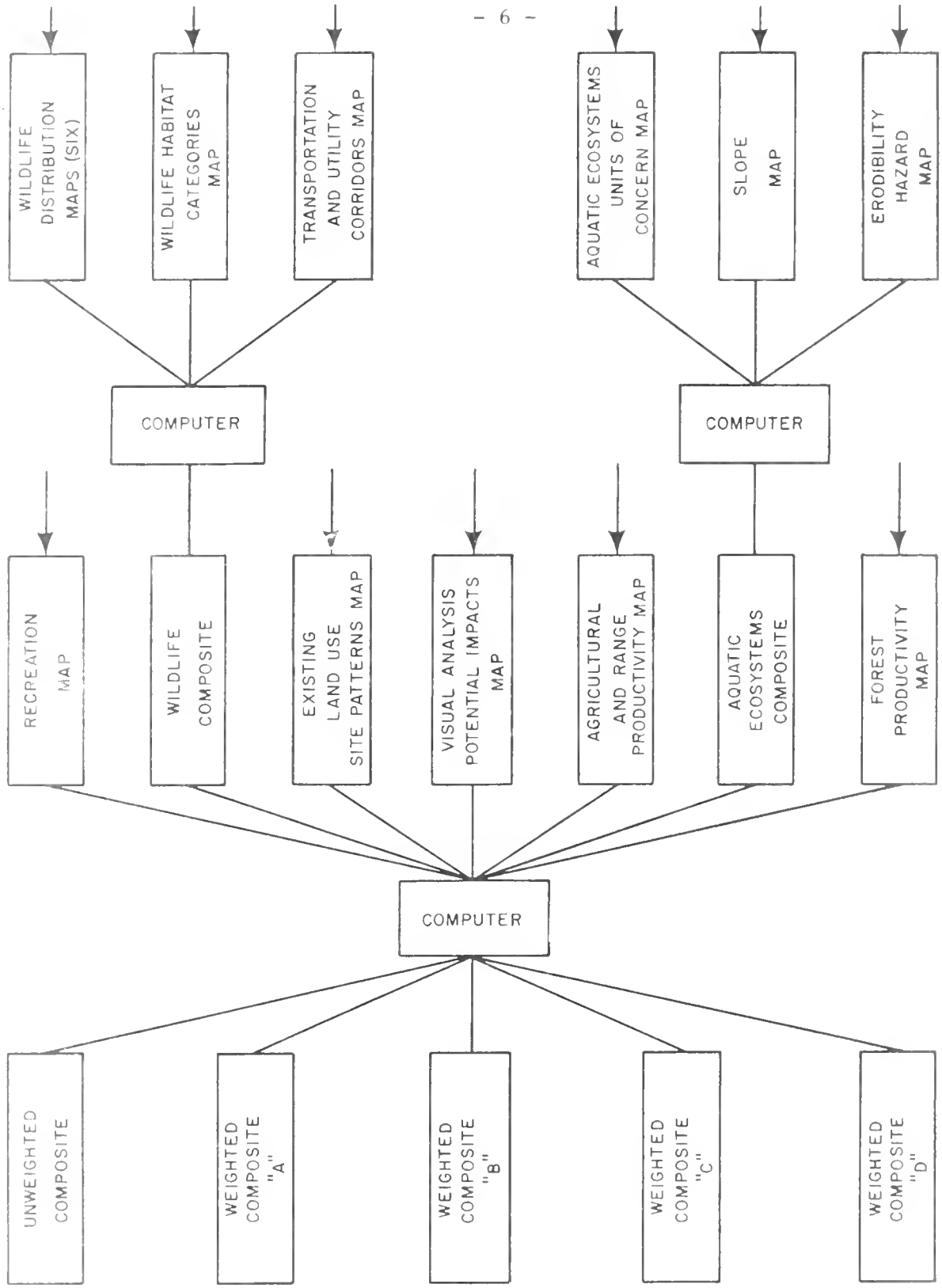
Additionally, a certificate may be revoked or an application voided if false information has been submitted by the applicant (Section 70-818, R.C.M. 1947).

B. Administration

The Energy Planning Division was created within the Department in 1973 to administer the siting act. Over the past three and one-half years, EPD has primarily concentrated its efforts in the extensive studies required to evaluate facility applications. However, the division also has undertaken planning activities and has developed tools to aid in the siting process.

One of the most important problems confronting a siting agency is the organization of large volumes of information into a format or process which will permit orderly consideration of all necessary facts as well as comparison of conflicting elements for decision-making purposes. A team of experts can use basic resource data, and through a combination of professional judgment, familiarity with a given study area, and manual comparison of maps, can evaluate various alternatives and ultimately recommend a relatively optimal area or corridor for a proposed facility. The division has generally employed all of these steps in considering transmission facility applications. However, many facility applications are contested at some point in the certification process and since the state must be able to demonstrate exactly how each specific environmental factor has been evaluated, documentation of the process is essential. Also, duplication or reproduction of study results may become necessary. Therefore, the division has been developing a methodology to meet these needs. A methodology ideally should provide a logical breakdown of analytic steps which include all of the evaluation requirements listed in the siting act. The need for a facility should be established before comparative analyses of alternative energy sources, site locations and design technologies are performed. When choices have been made among these various alternatives, the natural and cultural environmental impacts of the proposed facility can be identified and studied. Environmental, economic, social and engineering factors must all be taken into account in evaluating these impacts. This process represents an ideal study model which has not yet been applied in the specified sequence. The reasons for this will be discussed in the following subsection.

The division has made progress in developing a process for evaluating and comparing the various resource elements included within the geographic study areas associated with various transmission facility applications. It is virtually impossible for a single site or corridor to minimize all types of adverse impacts on all resource elements. Therefore, values or measures of "importance" must be assigned to these elements in order to make trade-offs or comparisons between them. The elements are locationally plotted on maps. Figure II-1 on the following page presents an example of the maps and the analysis process used in the division's study of the Anaconda-Hamilton transmission line application. Each item in the legends of the maps shown in Figure II-1 is assigned a weight or number value which conveys its relative compatibility or incompatibility with a transmission line. Each complete map is subsequently assigned an overall weighting which establishes its importance relative to the other maps. After the weightings have been assigned, the maps may be overlayed, combined and compared through a computer process to reveal the areas or corridors where least impact could be expected to occur.



RELATIONSHIPS OF THE MAPS USED IN THE CORRIDOR SELECTION PROCESS OF THIS STUDY

(ARROWS INDICATE INPUT OF ORIGINAL RESEARCH AND LITERATURE REVIEW)
(Dept. of Natural Resources and Conservation 1976)

Figure II-1

The computerized aspects of the process provide important flexibility in allowing EPD to make many types of comparisons between areas, using different combinations of weights for the various environmental elements. This reveals how different emphasis on the concerns can alter the desirability of a given corridor and helps insure that all options are considered. The computer process is discussed more fully in Section VI of this report.

The principal fact which must be understood is that the above process is only as useful or as accurate as the information and professional thinking put into it. The process will accommodate an almost infinite amount of data analyses, but an individual or team of individuals must define the relative importance of the elements used in the analyses. These types of judgments are unavoidable, but to the greatest extent possible, they should reflect existing state policies.

The Department has been responsible for negotiating several planning agreements between the State of Montana, the U.S. Forest Service (USFS) and the Bureau of Land Management (BLM). These federal agencies are responsible for administration and management of significant units of land in the state, as well as the forest and mineral resources within those areas. Since both agencies are responsible for conducting studies related to siting activities within their respective areas of jurisdiction, and since the future siting of energy facilities in Montana, particularly transmission lines, is likely to involve federal lands, the planning agreements are beneficial to all parties. A cooperative agreement with the USFS was signed in December 1973. It provides for joint development of an acceptable process for energy transmission planning. The agreement provides a basis for exchange of resource and land use data needed by both agencies in making siting decisions. The two agencies also expect to collaborate in developing the computer programs and procedures required to store, analyze and display the data. A memorandum of understanding between the state and the BLM was executed in June 1975 and is primarily oriented toward the coordination of land use studies and data collection activities and development of complementary land use planning systems. There is also provision for exchange of land use information and mutual review of related environmental impact studies. A more recent memorandum of understanding between the state, USFS and BLM was executed in June 1976. It complements the earlier agreements and is specifically intended "to provide guidelines for the three agencies to effectively work together on planning, programming and management issues related to major facilities" set forth in the Major Facility Siting Act. Major objectives include establishment of siting decision criteria, definition of unsuitable areas for siting and definition of a public involvement process. Also, guidelines for joint administrative efforts on individual facility applications are to be developed to meet short-term planning needs. It is hoped that these planning agreements will provide a strong basis for coordination of federal-state activities in the future, especially as mutual responsibilities are concentrated in siting-related issues.

C. Discussion

The Montana Major Facility Siting Act has two weaknesses which have hindered the attempts of both applicants and the state to effectively comply with the requirements and intent of the law. These weaknesses are best described as (1) an inadequate planning and informational framework to guide the siting of energy facilities, and (2) inadequate scheduling of the various procedures required by the act.

The siting act provides an extensive list of factors which must be included and evaluated in a facility application (Section 70-816, R.C.M. 1947). A potential applicant has this list to guide preparation of an application; however, nearly all of the elements are oriented toward determining the total impact the facility would represent, while very few elements provide specific guidance for selecting an optimal site or corridor. Therefore, in the planning stages, the applicant selects a site based upon the criteria he considers most important and at the point that an actual application is filed, considerable amounts of time and funds have been invested in studying that specific location.

As indicated in the siting act, the state must evaluate the facility and the site which have been proposed in an application. Although the applicant is required to submit information concerning alternative sites which have been considered, the state is in an extremely unfavorable position to determine whether the proposed site is the optimal choice. The applicant's criteria may be in conflict with the state's responsibility for minimizing adverse impacts, but unless the state initiates extensive siting studies at alternative locations, the possibility of relocating a proposed facility appears slight. This is especially true for major facilities other than transmission lines. Also, there is no mechanism for selecting alternative sites for study.

The most essential problem facing both applicants and the state is the lack of a geographically oriented framework of criteria to guide the actual siting of facilities. The environmental elements listed in the siting act could be adapted to this purpose, but thus far, this type of planning has not taken place, primarily due to lack of funds and lack of specific authorization to include the results of such planning in the state's siting regulations.

One siting inventory has been undertaken in Montana by the Montana Energy and MHD Research and Development Institute (MERDI) located at Butte. This organization is federally funded, primarily through the Energy Research and Development Administration, and is principally charged with furthering the development of magnetohydrodynamics (MHD) technology (a coal-fired process of energy production) and ultimately siting and operating a 500 megawatt MHD plant somewhere in Montana. MERDI has conducted a statewide study to identify candidate areas within Montana which will potentially yield a suitable site for the MHD facility. The statewide study used 1:1,000,000 scale maps and considered the following criteria:

(1) Meteorology (air dispersion characteristics).
(2) Hydrology (volume of stream flow).

(3) Seismicity (distance from geologic faults).
(4) Land use (legally protected areas).
(5) Socio-economics (proximity to community of at least 6,000 persons).

This study effort should be evaluated by the state. A state-sponsored siting study might be organized under entirely different criteria, but the MERDI experience can provide valuable insight into potential problems which may be encountered. For example, lack of reliable statewide data prohibited use of some criteria categories which MERDI had hoped to incorporate in its study. These included land productivity and wildlife population density categories. Also, meteorology was used as a study criterion, but the data were not detailed enough to allow more than an extremely broad evaluation which generalized the available information over large geographic areas. MERDI has taken its initial study, which identified candidate areas, through a second, more detailed screening level. The large candidate areas have thus been reduced to reveal smaller, suitable siting areas which are presently being studied to identify potential sites for the future MHD facility. Although a state siting study and criteria development process would be an independent effort with different goals, interaction and exchange of information between the state and related efforts such as the MERDI study should be encouraged.

Development of siting criteria and completion of a statewide siting inventory constitute a medium long-range planning goal which will partially correct the state's present reactive position in evaluating siting applications. However, other adjustments may be required to correct problems in the scheduling and general organization of the application evaluation procedures outlined in the act.

As noted in the methodology model described previously, the need for a facility should be established before engineering design and environmental evaluations proceed. However, the siting act requires that the entire evaluation of a major facility must be completed within a maximum time period of two years. This effectively prohibits the initiation of a separate study to determine "need" and essentially requires that all phases of the evaluation proceed concurrently. Policy determinations which go beyond the siting act are involved in interpreting the definition of "need" for new facilities. If these policy determinations are ultimately established, it may be possible to divide the siting evaluation period into a "need" study and a subsequent environmental study, especially if earlier state involvement in facility planning somewhat reduces the time required for some types of evaluations.

The long-range plans and five-year site evaluation requirements presently included in the siting act (Sections 70-814 and 70-815, R.C.M. 1947, respectively) are intended to address the need for earlier state involvement in site planning, but these provisions may not be functioning as intended. No funding source has been provided to the Department to carry out the five-year site evaluations and no studies of this type have been conducted thus far. Also, there is considerable debate concerning the time that energy demand projections decisively show that a new energy facility or facilities will be needed. Further, there is uncertainty regarding the time the potential need for a new facility becomes an integral part of a utility's long-range plans and begins to require plant design and site-related decisions. The relative newness of the Montana siting process has not

allowed time for extensive state involvement in the initial design and siting plans forfacilities proposed thus far under the siting act. The quality of the state's involvement in these plans in the future will partially depend upon the accuracy of the long-range plans and the openness of state-utility interaction prior to the filing of specific applications. The siting act's long-range reporting provisions may require further refinement to insure that their purpose is adequately served. Several types of provisions which could help meet this objective are featured in other state siting processes discussed in Section III.

The recently completed certification process for the Colstrip Units 3 and 4 application has revealed many opportunities for improving the siting act's hearing procedure as well as improving the interaction of federal, state and local government agencies, and the public both prior to and during the hearing process. The Colstrip hearing participants who submitted comments for this study agree that the length of the hearing and the volume of material in the hearing record could have been significantly reduced by clarification of contested issues and other types of planning prior to commencement of the hearing. This matter should be studied in detail before specific changes in the procedure are proposed, but it appears that the hearing examiner should be appointed to an early stage in the application process and given the responsibility for organizing pre-hearing conferences to clarify areas of agreement and disagreement between the potential hearing participants. More effective use of time could also be achieved by requiring that all testimony to be included in the hearing be submitted in advance. Additionally, the hearing examiner could streamline and clarify the entire proceeding for the Board if given the responsibility for summarizing the hearing record in a form suitable for decision-making. Another related matter requiring further study concerns the adaptability of the Montana Administrative Procedure Act to the requirements of a siting proceeding. If procedural adjustments improve the process, they should be considered.

The Colstrip application and hearing revealed a number of areas where coordination between government agencies could be improved. Numerous state, federal, regional and local government agencies have either statutory responsibilities or geographic areas of jurisdiction which are directly affected by siting issues and decisions. The Department is given lead responsibility for siting, but there is no clearly defined mechanism to insure that proper communication, interaction and coordination of interagency efforts is taking place. The siting act provides a basis for coordination between state agencies in requiring that agencies with expertise in areas affected by energy facility siting must make appropriate reports to the Department. However, the absence of well-defined siting objectives creates problems in achieving a comprehensive approach with these reports.

The Colstrip application is presently being evaluated by several federal agencies. Although these evaluations may potentially be aided by the state's hearing record and environmental studies, improved federal-state coordination at an earlier time could have avoided much of the confusion and complex legal entanglements presently surrounding the application.

The existing cooperative agreement and memorandums of understanding between the state, U.S. Forest Service and Bureau of Land Management provide for mutual exchange of land use and resource information applicable to siting and joint development of an acceptable siting process. The latter objective will provide a specific means for achieving sustained interaction and cooperation between the agencies, but it has not yet been fully implemented.

A separate, but related, matter concerns public input and the involvement of local government and community leaders in the siting process. As with the other topics discussed herein, earlier and more clearly defined forms of involvement would be a significant improvement. Public input in the siting process has thus far been characterized by testimony at public hearings and submission of written comments on specific applications and evaluations. Various forms of organized political activity have supplemented this input. The ultimate effectiveness of the former types of involvement is, perhaps, questionable. More innovative and effective forms of public input would include participation in the site planning process through the development of siting criteria and the siting inventory. Public input in this type of planning would help insure that future site selections are made within a policy-oriented, informational framework which the public has helped construct. Alternative mechanisms for insuring public input in criteria development are discussed in Section III.

Public involvement in the application evaluation process also requires attention. If the certification and hearing procedures are eventually amended in specific ways, the form and content of public input should also be analyzed for possible improvement.

Further discussion of the various topics and problem areas outlined above will be presented in the following sections of the report.

III. SURVEY OF STATE SITING PROCESSES

Nearly all state siting legislation has come into existence in the past six or seven years with the objective of involving states in the energy facility planning and siting process. All 38 state siting laws (Council on Environmental Quality, 1976) have been oriented toward minimization of the various adverse impacts associated with energy generation and conversion. This objective has principally been served by requiring new energy facilities to apply for and receive state evaluation and approval before construction may begin.

A principal objective of this report has been the identification and investigation of siting activities in other states which have begun to move toward comprehensive involvement in the planning and siting of energy facilities prior to the evaluation of individual facility applications. This investigation may provide important guidance to development of the Montana siting process. Therefore, this section presents a review of siting activities in the States of Oregon, Washington, North Dakota, Minnesota, Maryland and California. It must be noted that other states not included in this study have also engaged in comprehensive site planning activities, but time constraints and the results of initial study research and communications have limited this review to the above listed states. It also must be noted that these states vary considerably in the extent of their involvement in site planning and in the approaches which have been applied to statewide siting inventories.

The following list includes key questions which have emerged during the course of this study in evaluating state siting processes in terms of comprehensive, long-range planning:

(1) Does the siting legislation provide a direct mechanism for development of a state siting plan, development of siting criteria and state involvement in the facility planning and site selection process prior to evaluation of a specific application?

(2) Are long-range plans required from any person intending to construct an energy facility in the state? Is there an enforcement clause or similar mechanism to insure serious compliance with the intent of these plans?

(3) Is the state authorized (required) to generate its own energy demand data and perform subsequent forecasting tasks relating to an independent assessment of the need for any proposed facility?

(4) Is there an adequate provision for staffing and funding to carry out comprehensive site inventory studies, energy demand analyses, and application evaluations?

(5) Is a mechanism provided for joint planning and interaction between the state and the utilities in serving the public interest?

(6) Is there provision for one stop approval of applications and authorization for the siting agency to coordinate activities of the various

federal, state, local and regional agencies with responsibilities or jurisdictions related to siting?

(7) Is there provision for public involvement in designation of siting priorities, development of siting criteria, and other types of site planning? Is the public informed or provided the opportunity to become involved in plans for new energy facilities at an early stage in the process, before major decisions have been made?

The States of Oregon, Washington, North Dakota, Minnesota, Maryland and California will be analyzed in the following subsections in terms of these questions.

A. Oregon

In 1975, the Oregon legislature created a Department of Energy which absorbed the former siting authority (the Oregon Nuclear and Thermal Energy Council) created in 1971. The legislature declared that "a need exists for comprehensive state leadership in energy production, distribution and utilization" (Section 469.300 et seq., ORS 1975). The department was specifically authorized to obtain all necessary information from producers, suppliers, and consumers of energy resources in the state to predict the timing of construction of future energy facilities. The department presently includes about 30 staff members and has a budget of approximately $2 million over the next biennium (Woods 1976).

The siting council, retitled the Energy Facility Siting Council, is a part of the energy department. The council was directed by the original siting law (1971) to conduct studies, investigations, research and programs relating to all aspects of site selection, and after public hearings, to designate areas within the state that are suitable or unsuitable for use as sites for nuclear, fossil-fueled and geothermal power plants.

A statewide siting task force was appointed by the Chairman of the Nuclear and Thermal Energy Council in June 1972 to undertake the site designation study and make recommendations to the council. The state was divided into three sections--Eastern Oregon, Oregon Coast, and Western Interior Oregon (Oregon Nuclear and Thermal Energy Council (ONTEC) 1974) and evaluated for the following five parameters: (1) natural resource areas; (2) meteorology; (3) population; (4) water restrictions; and (5) geology. Each parameter was considered individually in terms of each of the three types of energy facilities. Natural resource areas and water restrictions were considered important in siting all types of power plants. Meteorology was most strongly considered in fossil fuel plant siting, while population and geology were more closely related to nuclear plants (ONTEC 1974, p. 0-2). Natural resource areas included national parks, wilderness areas, wildlife management areas and refuges, and other types of special or legally designated resource areas. The meteorological evaluation was based upon "elements which affect the fate of appreciable quantities of air contaminant emission to the atmosphere or emissions which may produce other significant

meteorological effects" (ONTEC 1974, p. 2-1). Broadly defined areas such as confined valley floors were considered unsuitable for siting. The population parameter applied a population proximity concept as a measure to suggest whether or not the population in a region is sufficiently dispersed so that there would be a high probability of finding suitable nuclear sites. The water restriction parameter was determined by existing legal and policy constraints affecting water withdrawals from each drainage basin. These restrictions were compared with the water requirements of a 1,000 MW plant, and the various tributaries subsequently were rated unsuitable, less suitable or suitable for siting. Geology considerations were described in terms of geomorphic provinces and included earthquake potential, active faulting and volcanism. All five of the parameters were designed to identify broad geographic areas. Extensive evaluations using specific plant designs would be required to determine the true suitability or unsuitability of any specific site.

The siting council was specifically directed to encourage the voluntary cooperation of the people, municipalities, counties, industries, agriculture, and other pursuits, in establishing standards for site selection. The parameters used in the siting study were developed by the task force and then presented to the public for comment and modification.

The siting council amended the task force's study before adopting the results into the siting rules and regulations. The entire water restriction parameter was omitted. The council decided that applicants should deal with the problem of water availability in terms of specific plant design proposals. The council also omitted the "less suitable" designation which the task force had assigned to some areas because there was no legal provision to support it. The "less suitable" areas were redistributed between suitable and unsuitable designations. The council also added a new study parameter, prime agricultural land. This parameter was based upon U.S. Soil Conservation Service classifications and was defined in terms of a specific number of acres in each of the three sections of Oregon which can be considered for future siting.

The areas designated suitable and unsuitable in the rules and regulations are subject to re-evaluation and may be amended either by the council or through petitions filed under Oregon law. By rule of the council, construction of thermal power plants will not be permitted in areas designated unsuitable. However, the council is presently concerned that lawsuits may result if an application is made for a site in an unsuitable area and subsequently denied because of location. It is hoped that negotiation can resolve such problems if they arise.

Oregon law requires that an applicant must file a notice of intent to file an application for a site certificate at least twelve months prior to actually filing for the certificate. The notice of intent must identify the proposed site for the facility and a fee of $5,000 must be submitted for each site so indicated. Copies of the notice are then sent to a specified list of agencies and the cities and counties affected by the application for comments and recommendations. This section is intended to provide greater opportunity for the public to become aware of utility plans before the site certification process begins (even though these

plans should be reflected in long-range plans) and to allow for expression of opinions, which, if opposed to the application, could lead to public hearings. The council is also required to designate the governing body of a city or county where a proposed site is located as a special advisory group when an application is filed.

Discussion

Oregon's siting process contains many significant features which could provide guidance to future siting efforts in Montana. The statewide siting study was broadly based and was generally designed to reveal areas of outstanding unsuitability for power plant sites. The parameters initially defined by the siting task force are based upon existing federal and state environmental protection and public health and safety statutes. Prime agricultural land was defined as a resource of importance and included as an additional siting parameter through a direct policy determination of the siting council. The unsuitable areas designated by the study were formally included in the siting rules and regulations and the state considers them closed to future siting. Montana could conduct a statewide study of this type. Further discussion of this topic will be presented in the analysis at the end of this section.

One aspect of Oregon's energy research activities has presented a problem which directly affects the state's long-range site planning efforts. As mentioned previously, the Oregon Department of Energy was established in 1975 and was directed to prepare independent long-range energy forecasts which could be used to predict the timing of construction of future energy facilities. The department's preliminary efforts to meet this responsibility were challenged from several standpoints, including accuracy of data input, application of econometric analysis processes, and general conclusions. This type of problem is best understood when considered in terms of the complexities involved in making reliable energy demand forecasts. Additionally, the Oregon energy agency was making its first effort in this area. If Montana eventually assumes a similar energy forecasting responsibility, initial planning and evaluation of the implementation processes and problems encountered elsewhere will be essential. The following discussions of Maryland's and California's siting situations present different perspectives on this topic.

Oregon's siting law contains two public involvement provisions which the State of Montana should consider. These are, respectively, the notice of intent requirement and the directive which requires the siting council to encourage voluntary cooperation from various sectors of society in establishing standards for site selection. The notice of intent clause provides the opportunity for the public to become aware of potential site proposals and to express opinions at a preliminary point in the siting process. The state and the applicant are given

strong indications of public attitude before large amounts of time, funds and study efforts have been committed to a particular site. The state and the applicant also are given additional time to clarify major issues or points of disagreement concerning a particular application before official state studies begin. The 12-month "notice" period provided by Oregon law would not be adequate for evaluating the potential impacts of a site on a quantitative basis, but qualitative impact determinations could be made. However, some source of funding must be provided to support this activity.

B. Washington

The energy facility siting situation in the State of Washington is substantially different from the other states discussed in this section because approximately 80 percent of Washington's energy is supplied by publicly-owned and operated utilities which collectively comprise the Washington Public Power Supply System. The long-range plans of these utilities, as well as all other utilities serving the general Pacific Northwest Region, are published annually in a document entitled the "West Group Forecast". The availability of this information essentially explain the absence of a clause in the Washington siting law requiring submission of long-range utility plans. Additionally, the siting law does not require a state-wide siting inventory.

Washington's energy office was established by the 1975-76 Legislature and was given responsibility for collection of all types of energy-related data and preparation of analyses "necessary for development of recommendations with respect to the timing of construction of additional facilities and other energy programs (Section 80-50 et seq., R.C.W. 1976). Additionally, this office is responsible for development of conservation plans, preparation of contingency plans for dealing with energy shortages or emergencies, and generally advising and supporting other state agencies in energy-related matters.

The Washington siting agency is the Energy Facility Site Evaluation Council. This council was established through 1976 amendments to the original Washington siting legislation of 1970 and is comprised of the directors of 14 state executive departments, as well as temporary representatives from each county affected by individual site applications. The director of the energy office serves as the council's non-voting chairman. The council's primary responsibility is the evaluation of energy facility site applications. Since both the council and the energy office function with very limited staffs, consultants are contracted to conduct the site evaluation studies. These studies and the recommendations of the council are forwarded to the Governor, who makes the final decision to approve or disapprove an application.

The law presently requires the director of the Department of Commerce to work with the energy office in expending funds appropriated by the Legislature to acquire, develop and operate land and facilities which will foster development of the state's nuclear economic potential. This provision has existed since 1961 and was utilized to lease land for burial of radioactive wastes. It may be repealed or transferred

to the energy office in the near future (Adair 1976).

Although the siting council was not given authority to undertake a statewide siting study, the siting law does provide for preliminary review of potential sites if an applicant chooses to request such a review prior to actually filing an application and furnishes a $10,000 fee to finance the study. It appears that the state has no authority to modify utility plans at this stage, but the process is designed to reveal problems with potential sites which could result in many types of modifications in the facility application (up to and including relocation of the proposed site). Additionally, the process provides a means of informing the public of facility siting plans, although there is no specific provision for public input. The first site review conducted under this provision is presently being completed. The siting act also contains a "notice of intent to file" provision similar to that required by the Oregon law, except that no fee is required and the notice period is 90 days. The notice must indicate the general location for the proposed facility.

In the absence of a state-initiated site screening study, the public utilities of the Washington Public Power Supply System commissioned their own statewide siting study. The initial phase of the study, published in December 1975, considered seven parameters in identifying suitable site candidate areas (WPPSS 1975; Adair 1976). The study has since progressed toward identification of nine potential specific sites, with emphasis on nuclear facilities. No actual site applications have been based upon this study to date, but the state considers it a useful planning tool containing information which will be considered in reviewing future site applications (Adair 1976). It should be noted that Washington does not have a statewide land use plan. If such a plan is ultimately required, the state would have to initiate its own statewide site screening study (Adair 1976).

The analysis and ultimate determination of need for a proposed facility has not been a well defined process in Washington. The siting council's role in assessing need is particularly ambiguous because, on one hand, the council is required by the state environmental policy act to analyze alternatives to a proposed facility (and must, therefore, indirectly deal with the need to be filled by the facility). On the other hand, a need analysis is not mandated in the siting act and apparently may not be considered in the council's consideration of a facility application. Therefore, the siting council's role is rather strictly confined to site evaluation.

Discussion

Washington's siting agency has the most narrowly defined area of jurisdiction and analysis responsibilities of any of the states considered in this study. The authorization to acquire all pertinent energy-related information from energy producers, suppliers, and consumers is granted to the state's energy office, and the data analyses and forecasts subsequently developed by this agency are used

by the Governor in approving or denying energy facility applications.

Washington's siting situation is comparable to Montana's in some respects, although Montana's siting agency is responsible for determining the need for proposed facilities. Since the Washington siting act does not call for a statewide siting study and also does not require an applicant to submit to a preliminary site review process or to reveal the location of a future facility except as provided in the 90-day notice of intent period, the state must evaluate site applications solely on a case-by-case basis. The public nature of most utility planning activities in Washington may offset this situation. Also, long-range site planning advantages of a statewide site screening study have been provided by the Washington utilities. However, if this type of study tool is to provide the widest possible basis for use in state siting decisions, it should most properly be undertaken by the state with input from all concerned parties, including utility interests and the public at large.

C. North Dakota

The North Dakota Energy Conversion and Transmission Facility Siting Act was passed in the closing days of the 1975 legislative session, but for purposes of actual siting, the effective date of the act was December 1975, when the siting rules and regulations were adopted. The siting act and the rules and regulations must be considered together in order to obtain a complete understanding of North Dakota's siting process.

The North Dakota Public Service Commission (PSC) was assigned the responsibility of administering the siting legislation. The first task of the commission was to "initiate a public planning process where all interested persons can participate in developing the criteria and standards to be used . . . in preparing an inventory of potential energy conversion facility sites and transmission facility corridors and to guide the site suitability evaluation and selection process" (Section 49-22-04, N.D.C.C. 1975). All future applications for sites will be evaluated in terms of this inventory; however, all applications filed thus far have been emergency cases which have been processed on an expedited time schedule specified in the act (Englerth 1976).

Two citizen advisory committees were formed in May 1975 to propose the criteria for locating energy conversion facility sites and transmission corridors, respectively. Several public meetings were held by the committees during the summer of 1975 to gather public input for criteria development.

The committee was guided by a list of evaluation factors included in the siting act and also by North Dakota's policy of siting facilities so as to produce minimal adverse effects on the environment and the welfare of the state's citizens. It was decided that certain areas of the state would be designated

"exclusion" or "avoidance" areas because of their uniqueness or susceptibility to adverse environmental effects. Exclusion areas are completely removed from siting consideration and avoidance areas are considered "last choices" which would be utilized only on clear demonstration that no reasonable alternatives exist.

The criteria developed for the siting inventory were based upon the exclusion and avoidance categories and included legally designated parks, wildlife reserves and historic sites as well as other types of scenic, recreational and natural areas at the national, state and county administration levels. Additionally, critical habitat areas for endangered or rare animal and plant species were included as were areas of prime farm land and irrigated land and areas within city limits or the boundaries of military installations. It was also recognized that "buffer zones" would be required to preserve the quality or nature of some criteria types. The width of the buffer zones were determined on a case-by-case basis. The exclusion-avoidance criteria were mapped for each county in the state and published in July 1976 as the site inventory.

At present, the siting act calls for criteria and an inventory to designate specific potential energy conversion sites and transmission facility corridors. It appears, however, that this provision may be amended in the near future, thus leaving the task of specific site identification to applicants, who can then make site applications based upon specific facility design criteria as well as the information provided in the inventory (Englerth 1976).

The criteria selection committees developed a number of site-specific criteria which were not actually mapped in the inventory but which are intended to provide guidance to future site selection efforts. These criteria fall within the avoidance categorization and include: (a) areas where surface water drainage or groundwater flow patterns would be adversely affected; (b) zones surrounding rural residences, businesses or communication facilities; and (c) areas of unspecified scenic, recreational or paleontological significance. Other socio-economic-related criteria are also included.

Additionally, a separate listing (partially presented below) delineates criteria which would cause the PSC to give preference to a proposed site:

(1) Recycling of conversion by-products and energy conservation through location, process and design.

(2) Utilization of available labor in the state.

(3) Economic benefit to residents of the area and state in general.

(4) Non-relocation of residents.

(5) Economies of construction and operation.

(6) Commitment of a portion of the energy for use in the state.

(7) Use of a primary energy source or raw material located in the state.

It is unclear how some of these positive site selection criteria may actually be dependent upon specific sites; nevertheless, they are specific factors for applicants to consider in order to receive the most favorable evaluation of their site proposals. All of the criteria discussed above are officially included in North Dakota's siting rules and regulations.

North Dakota's siting process requires two types of long-range plans from potential applicants. The ten-year plans must include information regarding demand projections and future facility needs, as well as a description of on-going efforts by the utility to coordinate its plans with other utilities to meet regional needs. A second long-range plan requirement concerns "facility development plans" which must be submitted by "every utility which owns, operates or plans within the next five years to start construction, own, or operate" an energy facility (Section 49-22-06, N.D.C.C. 1975). The plans must be submitted annually, following publication of the site inventory and criteria described above. The plans must identify the tentative preferred site (or corridor) and at least one alternative and give preliminary indication of the potential environmental impact of the proposed facility. The act presently states that sites or corridors may be selected from the inventory of potential sites and corridors published by the commission or they may be selected and proposed solely by the utility. This provision presumably will be amended if the provision requiring state identification of sites is revised.

An additional provision included in the rules and regulations requires an applicant to file a letter of intent to file an application at least one year prior to beginning construction of a facility. This enables the commission to determine if it has jurisdiction over the facility and to plan for processing the application. The applicant must obtain a certificate of site compatibility before beginning construction, but it should be noted that after July 1977, the processing time for a major facility application will be only six months and for a transmission facility, three months. This expedited process will depend upon the pre-application planning and evaluation capability provided by the criteria, the siting inventory and the various long-range plans. However, the shortened evaluation period will require careful review in the future to ensure that enough time is provided to make adequate studies.

Discussion

North Dakota's siting legislation has not existed long enough to be analyzed in terms of its complete operational capability. The potential for systematic state involvement in applicants' site selection activities and for examination of the need for facilities through a ten-year period are evident. North Dakota has not specifically addressed the problem of insuring compliance with the intent of the long-range plan requirements nor has it chosen to pursue detailed involvement in energy demand forecasting through its siting act.

Public involvement in North Dakota's siting process is partially defined by a provision which directs the siting commission to appoint citizen advisory committees to assist in criteria development. Additionally, there is provision for appointment of "evaluation and selection committees" for each facility application received. These citizen committees serve in an advisory capacity and are composed of three utility representatives, one representative from the Montana Department of Agriculture, and representatives from each county and city where a facility would be located. This type of committee has not yet been organized for a specific application (Englerth 1976).

One serious problem in North Dakota's siting process has been the lack of provision for adequate staffing or funding to meet the mandates of the siting act. A minimal staff from the state's land reclamation division was assigned to perform staff responsibilities for the siting act. This group's activities have been basically limited to evaluating the information supplied with the transmission facility applications thus far received under the siting act. The siting inventory was conducted by a private consulting firm. A recommendation to the legislature for increased staff and funding is expected in the immediate future.

The general structure of North Dakota's site planning activities could be applied to Montana in terms of scope and the types of criteria which have been developed. This consideration will be discussed further in the analysis at the end of this section.

D. Minnesota

The Minnesota siting act was passed in 1973, and was used as a pattern for several of the provisions included in the North Dakota siting law. These two laws and their accompanying rules and regulations feature similar requirements for a siting inventory to identify suitable sites and corridors and include similar sets of criteria to guide the selection and evaluation of preferred sites. The two laws also feature somewhat similar long-range plan requirements and both laws include provisions for citizen advisory committees to assist in criteria development and to provide public input into the overall siting process. The description of these portions of the North Dakota law also applies to the Minnesota siting situation.

In Minnesota, the determination of need for a proposed energy facility is made by the state energy agency before the siting authority, the Minnesota Environmental Quality Council (EQC), completes its site-related studies. These two agencies and processes have a complex relationship which requires further clarification (Hynes 1976). The energy agency is responsible for conducting independent energy demand and forecasting studies which are compared to the 15-year, long-range plans required annually from the state's utilities. At present, the energy agency issues a certification of need for a specific facility application rather than certifying

the need for a certain amount of energy generation. This affects siting considerations in terms of plant size and design and thus infringes, to some degree, upon the siting evaluation options open to the EQC. A clearer definition of the responsibilities of these two agencies is necessary.

In addition to 15-year, long-range plans, utilities must submit five-year facility development plans similar to those required by North Dakota. Minnesota's siting law does not include a "notice of intent" clause.

The funding provision for Minnesota's siting process is notable in that the EQC's baseline environmental studies, siting criteria development, site inventory preparation and other activities not involved in the evaluation of specific applications are financed from an assessment made annually by the council against the state's utilities. Each utility's share is based on a percentage of its annual gross revenue from retail kilowatt-hour sales in the state expressed as a ratio of the total sales and revenue of all utilities in the state. The council's assessment must be based on its actual annual expenses with provision for adjustments of overpayments or underpayments for each utility.

Minnesota's siting process features a strong general policy of public participation. This includes the establishment of a power plant siting advisory committee which may be composed of 15 to 25 persons appointed by the EQC for a one-year term. The committee must include a majority of private citizens and at least one representative each from the utilities, regional development commissions, county governments and municipal governments. Additionally, advisory committees are formed for each individual site or corridor application considered by the EQC. The EQC is also required to hold an annual public hearing regarding its inventory of potential sites and corridors, its regulations and any other aspects of its activities set forth in the regulations. These features should be closely examined for application to Montana's needs.

The Minnesota power plant siting advisory committee developed siting criteria and subsequently conducted a statewide siting inventory which identified suitable candidate siting areas from portions of the state not specifically removed from consideration by exclusion and avoidance type criteria. Minnesota's law presently requires the state to identify specific suitable sites. At the time the inventory was published in 1975, the identification of candidate areas was considered an interim step toward this goal.

The siting committee was aided by the EQC and an outside consultant firm in developing the siting criteria. The committee set up a series of educational forums to obtain information on the technology, environmental impact and primary policy issues involved in siting power plants. It was decided that nuclear and fossil fueled plants should be evaluated separately where their site requirements and environmental impact potential differed. Site requirements and site impacts relating to engineering or plant design characteristics were calculated for a 1,000 megawatt unit.

A number of policy issues required analysis and decisions before the inventory could proceed. The committee was aided by the following list of "preferred" site selection criteria included in the Minnesota siting rules and regulations (Minn. Regs., MEQC 74(c)(3)):

(aa) Preferred sites require the minimum population displacement and disruption of local communities and institutions.

(bb) Preferred sites minimize adverse health effects on human population.

(cc) Preferred sites do not require the destruction or major alteration of land forms, vegetative types, or wildlife habitat which are rare, unique, or of unusual importance to the surrounding area.

(dd) Preferred sites minimize the visual and audible impingement on waterways, parks, or other existing and proposed public recreation areas.

(ee) Preferred sites minimize the removal of valuable and productive land and water from other necessary uses and minimize conflicts among water users.

(ff) Preferred sites maximize reliability with respect to climate and geology.

(gg) Preferred sites permit significant conservation of energy or utilization of by-products.

(hh) Preferred sites are located near large load centers.

(ii) Preferred sites maximize the use of already existing operating sites and transportation systems.

(jj) Preferred sites allow for larger rather than smaller generating capacity.

The rules and regulations include a similar list of criteria for corridors and transmission line routes.

Some of the policy questions examined by the committee are presented below. Detailed statements which expressed the majority opinion on each issue were published with the site inventory (MEQC 1975).

(1a) Should water impoundment be allowed to provide make-up water during dry years from smaller streams?

(1b) Should a distinction be made in the kinds of impoundments to be used?

(1c) Should criteria be established for determining what portion of a stream can be diverted for storage and consumption?

The majority voted "yes" on all three questions.

(2) Should the inventory identify areas suitable for power parks (assumed generating capacity of 15,000 to 20,000 megawatts)?

The majority voted "no", due to the lack of adequate information needed to answer important questions raised by this issue.

(3) Where should power plants be located relative to urban areas?

The committee favored locating fossil fuel plant sites close to urban areas, but stated that nuclear plant siting should be more conservatively considered in relation to safety parameters.

(4) What consideration should be given to proposed land uses?

Proposed land use was left for future, more detailed investigations in regions identified as siting candidate areas; existing land use was included in the study.

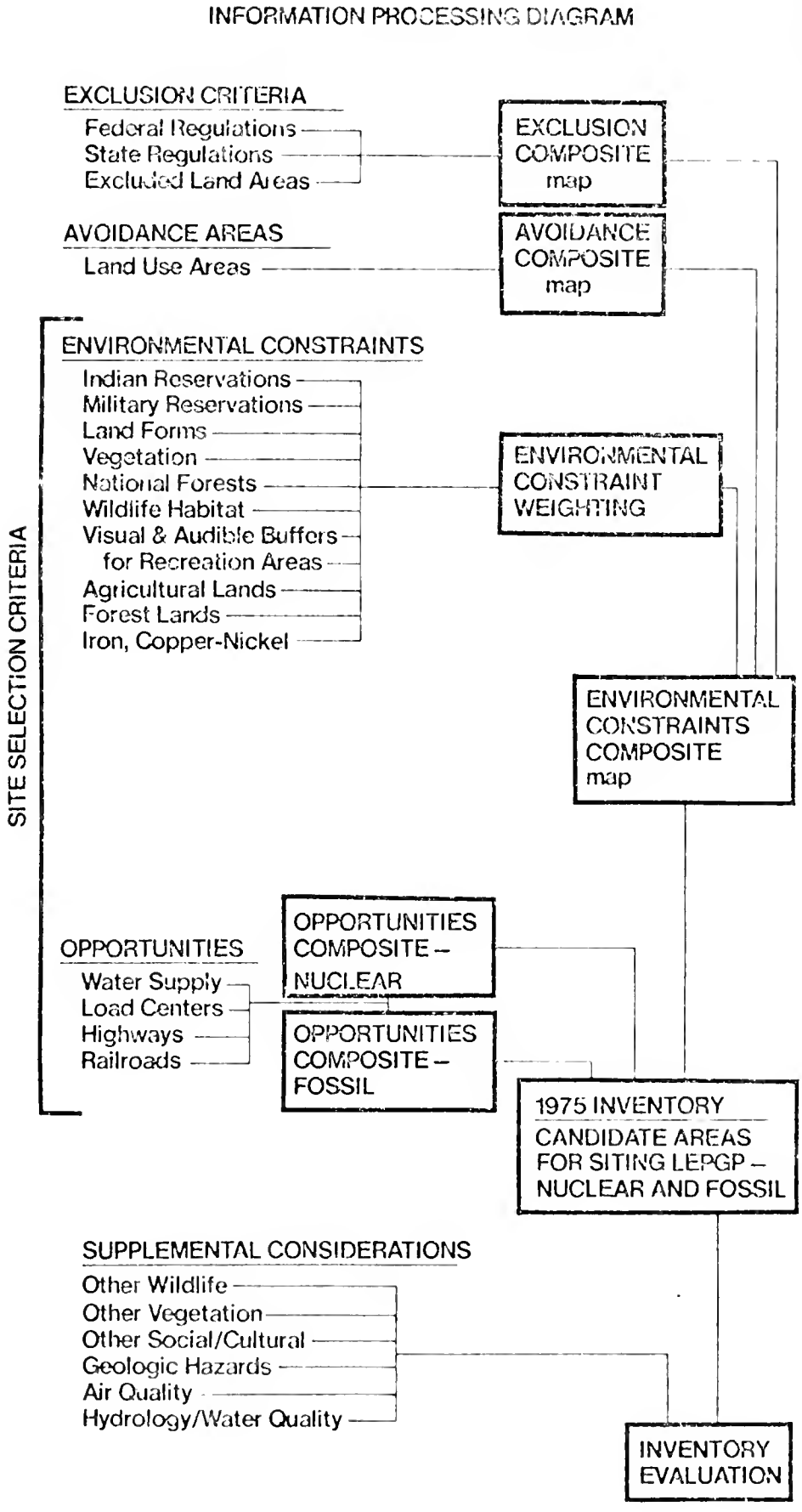
(5) Should unreliable or marginal data be used?

This issue was resolved by creating a "supplemental considerations" category which included important information not considered accurate enough for inclusion in the inventory.

The state was inventoried at a mapping scale of 1:500,000. As noted above, there were inadequate existing data for some of the environmental elements considered most important in determining suitability or unsuitability for siting. These supplemental considerations included air quality, hydrology, water quality and geologic hazards. The environmental elements which were included in the inventory were either considered constraints to siting or opportunities favorable to siting. These elements were classified and combined by the process shown in Figure III-1 on the following page.

The final results of the inventory included the identification of 40 candidate siting areas for either nuclear or fossil fueled power plants. The areas ranged in size from 428 square miles to 3 square miles.

Figure III-1


INFORMATION PROCESSING DIAGRAM
SITE SELECTION CRITERIA
EXCLUSION CRITERIA
Federal Regulations
State Regulations
Excluded Land Areas
EXCLUSION COMPOSITE map
AVOIDANCE AREAS
Land Use Areas
AVOIDANCE COMPOSITE map
ENVIRONMENTAL CONSTRAINTS
Indian Reservations
Military Reservations
Land Forms
Vegetation
National Forests
Wildlife Habitat
Visual & Audible Buffers for Recreation Areas
Agricultural Lands
Forest Lands
Iron, Copper-Nickel
ENVIRONMENTAL CONSTRAINT WEIGHTING
ENVIRONMENTAL CONSTRAINTS COMPOSITE map
OPPORTUNITIES
Water Supply
Load Centers
Highways
Railroads
OPPORTUNITIES COMPOSITE – NUCLEAR
OPPORTUNITIES COMPOSITE – FOSSIL
1975 INVENTORY
CANDIDATE AREAS FOR SITING LEPGP – NUCLEAR AND FOSSIL
SUPPLEMENTAL CONSIDERATIONS
Other Wildlife
Other Vegetation
Other Social/Cultural
Geologic Hazards
Air Quality
Hydrology/Water Quality
INVENTORY EVALUATION

Discussion

Minnesota's siting inventory was published in mid-1975 with the expectation that review by the public, the utilities and other state agencies would result in modifications of the criteria and the candidate areas maps. However, the inventory was not accepted by the EQC. Some of the major criticism of the study originated within the Minnesota state agencies. A major topic of contention has concerned the relative accuracy of the data which were used in the study and the effects created by eliminating other types of data.

Another major problem concerned public interpretation of the candidate area maps. The siting committee intended that the maps would provide geographic guidelines for the state and the utilities to consider in searching for suitable sites. The maps were not intended to precisely define areas where siting would be absolutely prohibited or specifically allowed. Sites could be proposed in areas not specifically designated as candidate areas, but this was not generally understood by the public, and the utilities expressed strong objection to the potential public pressure which they felt would result if the maps were formally accepted by the state and then not "followed" in future site proposals.

Still another related problem concerns the siting act's requirement that the state identify specific suitable sites. The candidate area inventory was intended to provide the principal basis for a specific site selection study. Since the inventory was unacceptable, the EQC has been meeting over the past year with other state agencies and utility representatives in an attempt to reorganize the criteria and resolve disagreements concerning the data to be utilized.

The problems of the Minnesota siting inventory must be considered by any state attempting a similar study. The absence of reliable data or lack of agreement on the relative worth of available data is a critical problem (see Section V for further discussion). Also, the exact use of the inventory must be decided at the beginning of the study. Exclusion criteria may be developed to define areas which are unsuitable for siting, but many specific policy issues must be explicitly defined before a general siting inventory can be used to legally close entire areas to future siting.

As was noted previously, Minnesota has a problem of jurisdictional overlap between its siting agency and the agency responsible for determining the need for new facilities. While it may be possible to alleviate this problem through better clarification of each agency's role, consolidation of the two functions under a single administrative unit would be a potentially more optimal arrangement.

E. Maryland

The Maryland Power Plant Siting Act of 1971 is one of the older siting laws and is certainly the most unique. The act is focused upon long-range site planning, scientific research for all types of power plant siting problems, and state acquisition of potential power plant sites for future use.

Utilities are required to apply to the Maryland Public Service Commission (PSC) for a certificate of public convenience and necessity before a power plant or transmission facility may be constructed. However, this procedure occurs near the end of the siting process. A description of the process and the accompanying program of siting research must begin with an explanation of Maryland's site funding provision. The siting law created an "Environmental Trust Fund" which finances all siting activities and research through a surcharge on the kilowatt hours of electric energy generated in the state. This surcharge is added to consumer power bills. According to the law, the surcharge may not be continued beyond 1985; in the meantime, it is providing an average annual operating budget of $7.5 million for the siting program. This budget is expended through a staff of seven professionals and a contractual structure involving approximately 150 scientists (Maryland Energy and Coastal Zone Administration 1976).

Maryland's Power Plant Environmental Research Program coordinates the scientific research contracts which account for most of the program's expenditures. This program is comprised of four sub-programs which are briefly described below:

Impact Assessment Program: This program monitors, assesses and models all types of environmental impact resulting from existing power plants and evaluates new technologies designed to minimize impact.

Research Program: Through this program, general ecological baseline studies and research of Maryland's environmental resources and socio-economic structure are applied to the problem of siting and operating power plants with maximum benefit to society and minimum detriment to the environment.

Site Evaluation Program: This program is responsible for detailed site suitability investigations at sites proposed by utilities and sites identified by the state. This work forms the basis of recommendations to the PSC for its consideration of all facility applications. Additionally, this program is responsible for adopting methodologies to predict future electrical needs and make independent demand projections for each utility service area in the state.

Site Acquisition Program: The purpose of this program is to identify, investigate and acquire an inventory of suitable plant sites for potential future use.

The site evaluation and site acquisition programs implement the long-range site planning objectives of Maryland's siting process. The PSC must undertake "a long-range environmental evaluation of power plant building sites . . . to facilitate providing adequate electric power on reasonable schedules at reasonable costs with the least possible depreciation of the quality of Maryland's environment . . ." (Article 66C, Section 768, Ann. Code of Md.). The PSC annually evaluates the long-range plans of Maryland's public electric companies and forwards a ten-year plan of proposed sites to the Secretary of Natural Resources. The Secretary is then responsible for preparing a preliminary environmental statement for each proposed site, and those sites deemed acceptable are investigated in detail through the Site Evaluation Program. The detailed site studies must be published

at least two years before any construction is expected to begin on those sites. An application for a facility must be filed at least two years prior to commencement of construction.

In addition to the activities described above, a cumulative environmental report on all power plants operating in the state is published biennially. This report addresses state environmental policy concerns and must include "a section devoted exclusively to the question of growth and the specific growth-related factors which necessitate specific additional increments of electric energy by development of a site in the ten-year plan". (Article 66C, Section 768(4), Ann. Code of Md.)

The state is authorized to purchase a number of facility sites sufficient to satisfy the growth requirements outlined in the biennial report. The siting law provides for a minimum of four and a maximum of eight potential plant sites in the site inventory. The four sites are to be distributed through four regions (Eastern, North-Central, South-Central and Western Maryland) which approximate the service areas of the main utilities in the state. In recognition of the tight certification and construction schedules facing utilities, the state makes these sites available to utilities whose proposed sites have been judged unsuitable or whose efforts to acquire a site have been unsuccessful. The purchase price of a site is based on the appraisals of two independent agents and a utility may lease or purchase the site from the state at its fair market value. The state estimates that during the period 1973-1985, it will have acquired six sites and sold four sites.

Maryland is just beginning to search for sites based on regional site screening methodologies such as those used in Minnesota, North Dakota and Oregon. Maryland has acquired one site in its south-central region and another site has been approved for acquisition in the north-central region. These sites were located through a general search for available tracts of land. For example, the site in the north-central region was federally-owned, surplus land (Massicott 1976). It was decided, however, that this approach presented too great a chance for overlooking sites which would cause the least adverse impact on surrounding areas. Therefore, two separate studies were initiated to develop and conduct an inventory process to identify candidate sites in Maryland's eastern and western regions.

The study relating to the western region is a demonstration project being conducted by Oak Ridge National Laboratories (ORNL) and the Nuclear Regulatory Commission. It is nearly completed. ORNL utilized a regional siting analysis method known as the ORNL Land Use Screening Procedure (LUSP) (Dobson 1976). ORNL-LUSP is a combination of methodological and data manipulation techniques, designed to simulate the results or consequences of alternative siting policies. The principal conclusion of the ORNL study, which would apply to any state or agency attempting to conduct a similar inventory, is that there is no "right" set of criteria, and thus, there are no "best" candidate siting areas except as these criteria and areas reflect the official siting policy of the region under study (Dobson 1976, p. 6-1).

ORNL applied 22 separate sets of criteria to different types of facilities in order to demonstrate the conclusion stated above and to portray the flexibility of the LUSP system. The study also experimented with several sets of values or weightings applied to the various elements included in the study. ORNL subsequently identified candidate siting areas in Western Maryland based on the many sets of criteria which it developed. The Maryland siting agency will now have to adopt specific criteria and select a final slate of candidate areas.

The ORNL study also tested the applicability of the Maryland Automated Geographical Information System (MAGI) to siting issues. MAGI is a geographic data base file which was designed in 1974 by the Maryland Department of State Planning to serve a variety of needs. The ORNL study concluded that "since the construction of a geographic information system is the greatest potential constraint to the development of an automated (site) screening procedure, the data base should be designed to serve diverse uses . . .. Costs can be minimized by including only those data variables which receive high importance weights on numerous criteria matrices." (Dobson 1976, p. 7-1). The study recommends that "siting criteria should be defined early enough to serve as guides in determining data requirements . . .. Geographic information systems constructed in . . . an a priori manner contain numerous variables which are expensive to obtain, and are relevant only to a few specific applications." (Dobson 1976, p. 7-3). On the whole, the ORNL study concluded that the MAGI data were extremely accurate and precise. The MAGI system therefore places Maryland in an excellent position to conduct its own automated site selection studies once policy and formal siting criteria are established.

The screening study for Eastern Maryland is being handled by a private consulting firm. Three specific sites are to be selected from the study results. The consultant is being assisted in criteria development by an advisory committee composed of representatives from each county in the study area, environmental groups, utilities and staff members from each of the state agencies participating in the power plant siting program. Two sets of site criteria must be developed: facility criteria, including minimum requirements for entry of various types of facilities into an area and the optimization factors for location (e.g., proximity to transportation and markets); and site and related physical/ecological and human/cultural criteria. Designation of candidate areas must be accomplished first; detailed site-specific studies within these areas will then lead to identification of three suitable facility sites. The consultant is required to hold three public information briefings during the candidate area selection process.

Discussion

Maryland's siting program is clearly committed by policy and statute to collect and analyze a tremendous volume of data. Also, the state has assumed the burden of public accountability for site selection. The state's position has been described as follows:

> "(T)he state, not the applicant, should decide on the significant issues to be addressed at any given site, collect the necessary data, define appropriate alternatives, and carry out the analyses. It is the ultimate of bureaucratic irresponsibility to ask the utilities to to prove beyond doubt that which is not provable. On the other hand, it is necessary that the agency given authority over siting have the responsibility for providing adequate energy at reasonable costs as well as for protecting the environment." (Md. Energy and Coastal Zone Admin. 1976, p. 4)

The program's funding scheme was organized to finance its demanding data handling responsibilities, but a recent report indicates that prior to January 1975 funding was lower than expected because the surcharge on electricity sales was not collected from out-of-state consumers of Maryland-generated power due to a loophole in the law. This problem was no sooner corrected than the rate of consumption of electricity fell and induced a second significant shortfall in expected revenue. The shortage has been absorbed primarily in the research and site acquisition programs, and as a result, several projects have become impossible to complete on schedule. Due to its dependence on revenues provided by the sale of electricity, the siting program could be adversely affected by energy conservation measures, increased efficiency in the use of electricity, and other occurrences which would result in reduced consumption of electricity.

The program's 1976 long-range plan indicates that national economic uncertainties have hampered utility planning and that uncertainties in both future demand and future capital availability have forced utilities to shift construction plans "from long lead time, capital intensive forms in favor of designs with shorter lead times, lower capital cost per kilowatt installed, and smaller capacity per unit" (Md. Energy and Coastal Zone Admin. 1976, p. 33). This trend disrupts the siting program's short-term site evaluation plans because it requires continual shifting of priorities in order to complete evaluations on schedule. The cost of evaluation has ranged up to $1.4 million per site for utility-owned sites and up to $1.7 million for state-owned sites. The cost difference is due to the need to develop plant designs for the state-owned sites. The state estimates it will be evaluating about 1.4 sites per year through 1985.

Maryland's siting act requires public hearings on facility applications and the long-range plans of the program provide for the notification and involvement of local government officials in site evaluation and site selection activities. Additionally, there is a Power Plant Siting Advisory Council which has general oversight and advisory responsibility for the siting program and is composed of representatives from the legislature, local government, utilities, environmental groups, universities and state agencies. However, it appears that a policy of general public involvement has not been strongly mandated by the siting act nor has it been adopted as a major policy objective of the program. The 1976 long-range plan states that:

"Efforts are now under way to develop an active, rather than passive, interaction with the public during the evaluation process at each site. Although the program is completely open to the public, with all reports, data and communications available, indications are that public interaction does not yet occur early enough in the evaluation process." (Md. Energy and Coastal Zone Admin. 1976, p. 35)

F. California

Through legislation which became operative in January 1975, California instituted one of the most comprehensive, long-range energy planning policies in existence. This legislation, entitled "The Warren-Alquist State Energy Resources Conservation and Development Act" (Section 25000 et seq., Ca. Pub. Resources Code 1975), created the Energy Resources Conservation and Development Commission (ERCDC) and assigned it the following responsibilities.

(1) Siting and certification of thermal power plants and electric transmission lines.

(2) Forecasting and assessment of energy demand and supplies.

(3) Development of energy conservation programs and standards.

(4) Development of a program for research and development in energy supply, consumption and conservation and the technology of siting facilities.

(5) Development of contingency plans to deal with possible shortages of electrical energy or fuel supplies.

The implementation of these five functions has resulted in an energy organization of considerable size headed by five commissioners from the following legally specified backgrounds: (1) law, (2) engineering/physical science, (3) environmental protection, (4) economics, and (5) the public at large. The commission is presently composed of approximately 230 staff members and is operating on a budget of approximately $25 million (Nichols 1976). Nearly half of this amount is federally funded with the balance supplied through a surcharge added to consumers' power bills.

The commission has expended most of its efforts thus far in organizing its various divisions and interpreting its responsibilities. However, the extent of the commission's mandate, especially as related to facility siting, is outlined in the following section of the law:

> The commission shall "collect from electric utilities, gas utilities, and fuel producers and wholesalers and other sources forecasts of future supplies and consumption of all forms of energy, including electricity, and of future energy or fuel production and transporting facilities to be constructed; independently analyze such forecasts in relation to statewide estimates of population, economic, and other growth factors and in terms of the availability of energy resources, costs to consumers, and other factors; and formally specify statewide and service area electrical energy demands to be utilized as a basis for planning the siting and design of electric power generating and related facilities." (Section 25216(b), Ca. Pub. Resources Code 1975)

A major responsibility of the commission is the preparation of a biennial report which, in part, is to include: a five- and ten-year energy demand statement as described in the above quote; a list (with maps) of all existing generating sites, indicating those where expansion has been identified as feasible; a list (with maps) of areas appropriate for additional electric generating sites, including capacity to be installed, which the commission has determined will be required to meet the ten-year energy demand. This list is only a small portion of the information required for the report, but it includes the main clauses relating to siting and indicates the potential future extent of California's involvement in energy facility planning. If this mandate becomes fully operational in terms of its information base and administrative organization, the commission could decisively share the energy planning position traditionally held by the utility industry in California.

Some significant portions of California's siting statute are listed and subsequently discussed below:

(1) Designation of siting authority,

(2) Submission of five-, ten- and twenty- year plans,

(3) Filing of notice of intent,

(4) Submission of site alternatives,

(5) Designation of multiple facility sites,

(6) Identification of unsuitable areas,

(7) Selection of candidate areas.

The commission has the exclusive power to certify all sites and related facilities. The issuance of a site certificate supercedes any applicable statutes or regulations of any state, local or regional agency, or federal agency to the extent permitted by federal law. It should be noted, however, that the California Public Utilities Commission (PUC) retains the authority to grant a facility a certificate of public convenience and necessity. ERCDC certifies the need for a facility and has exclusive authority over siting, but the PUC must evaluate a facilitiy's effect on the rate structure. The relationship between ERCDC and PUC requires further clarification in determining the need for specific facilities. The commission is

also authorized to adopt relevant land use, public safety, environmental and other standards, except for air and water quality, to be met in designing or operating facilities to protect public health and safety.

Utilities are required to submit detailed five-, ten- and twenty-year load forecasts on a biennial basis. The forecasts must be computed through a standard methodology established by the commission and must be accompanied by a listing of additional generation facilities which will be needed to meet the load and the general location of such facilities.

Prior to applying for certification of any specific facility, a notice of intent to file such an application must be submitted. This notice allows the suitability of the proposed site to be determined prior to the filing of the actual application. The notice must include three alternative site locations for the proposed facility(s), with a summary of the design criteria, fuels to be used, construction and operation methods, and a statement of the relative economic, technological, and environmental advantages and disadvantages of each alternative site. The commission is required to solicit comments on the notice from all appropriate agencies, hold public hearings and prepare both a preliminary and a final report. The notice may not be approved unless the commission finds the proposal in accordance with the ten-year forecast and the provisions of any applicable land use plans. Further, it must find the two alternative sites acceptable, although the commission has discretionary power to approve a notice based on a single site if the applicant has made a good faith effort to find acceptable alternatives and has failed.

If the commission finds all of the applicant's proposed sites unacceptable, in spite of a good faith effort by the applicant to comply with this requirement, the commission must identify a suitable site for the proposed facility. The commission has not yet adopted a plan or policy for implementing this provision, although the candidate area selection process discussed later in this subsection may be refined for this purpose.

An applicant may propose a site which will accommodate a potential maximum generating capacity in excess of the amount being proposed for initial approval. Such a proposal must contain information regarding the ultimate number and type of units proposed for the site, the installation schedule, the amount of cooling water ultimately to be required, and a statement of the impact at the site when fully developed. If the commission approves such a notice, the site is designated a potential multiple-facility site. The commission may specify conditions to insure that future additional facilities will not exceed the carrying capacity of the site.

All of the above described activities are completed before an application is filed The maximum time allowed to complete the review of a notice of intent and issue a decision is 17 months, although this time may be considerably shorter. The commission must issue a decision on an actual application within 18 months of the time of filing. Public hearings on the application must be held no later than 240 days after the filing date. A facility may not be certified unless it conforms

with the ten-year demand forecast established by the commission.

The commission's role in site selection was analyzed in a staff report compiled by the Facility Siting Division in September 1976. A specific provision in the law stipulates that parks, wilderness and natural reserves, areas for wildlife protection, recreation and historic preservation, and estuaries in a natural or undeveloped state shall not be approved for facility siting unless the commission determines such use is not inconsistent with the primary use of such land. The Siting Division has concluded that this provision effectively prohibits the siting of energy facilities in such areas.

The division has developed a "candidate area selection process" to compile a list of areas appropriate for additional electric generating sites. Public input and coordination with other planning and regulatory agencies must form the basis of this process. The division's position is stated as follows:

> "The development of (a) Candidate Area Selection Process cannot occur in a vacuum. The interests of the public, voiced as a concern among interested citizens, or as represented by other state agencies, must be considered in the long-term planning for energy facilities. Decisions which will seriously affect the options for siting future energy facilities will be made with or without participation by the Energy Commission. It should be considered that it will only be by direct participation in statewide planning that this Commission will retain necessary options." (CERCDC 1976a, p.7)

The staff assumes that a significant commitment to public participation must be made and it recommends that the commission develop and implement a program to achieve this objective.

With the above considerations in mind, the Siting Division sought to develop a siting selection methodology which would be responsive to all types of generation facilities as well as sensitive to the concerns of the public. The methodology was split into two levels: statewide screening and regional screening.

The first phase of the methodology requires designation of the statewide screening guidelines or criteria to be considered. These factors were initially identified within the staff and then modified through public input acquired at a series of four public workshops. In the absence of policy guidelines to establish the relative importance of various factors, it was decided that at the statewide level, factors would only be identified as "constraints" or "opportunities" and they would represent areas large enough to be mapped at a scale of 1:500,000. A constraint reflects some condition which would restrict siting or would be adversely affected by siting, while an opportunity identifies conditions or resources which offer advantages in siting. The factors ultimately selected for inclusion in the statewide screening process were further categorized in terms of high avoidance areas and significant areas. The former category includes factors representing "last choice" areas which are either an important resource or a hazard to potential sites. The latter category includes factors which should be given

special consideration in area-specific site planning, but which remain undefined in importance at the statewide level. An example of some of these factors or criteria and their respective classifications is presented in Figure III-2 on the following page.

These factors allow some reduction of the total study area to be considered. However, identification of actual candidate areas will not be accomplished at the statewide level. The statewide criteria are primarily of use in evaluating the site planning programs of utilities and in providing a framework to define how and where other agencies may have already limited siting options. The statewide factors also provide important "signals" to the utilities concerning the information and conditions the state considers important to siting.

The regional screening process has not been undertaken. Whereas the factors included at the statewide level were deliberately not weighted or compared, factors to be used in regional screening must be more specific and must be weighted in terms on their relative importance and potential magnitude of impact. Further, at the regional level, factors must be developed for each power plant type and fuel type. These may vary in importance in different regions. Also, public involvement in the regional screening process would require more emphasis than at the statewide level.

Discussion

The regional screening process was formulated, in part, to cope with the planning problem presented by California's geographic diversity. The regions of the state vary greatly in their geographic/natural environmental features as well as in their energy demand characteristics. It may be necessary to study the regions somewhat independently in order to accord all areas fair treatment.

Certain types of areas are granted special status under California law which removes them from favorable siting consideration. However, it is important to note that California has chosen to develop only "high avoidance" criteria rather than exclusionary criteria, except where areas are legally protected from siting. The commission probably does not have the authority to close an area to siting on the basis of its own policy delineations. Further, the California siting division staff believes that very few areas not already legally protected from siting are totally incompatible with all forms of energy facilities. For example, if all state forest lands were declared closed to siting, it could be argued that a small hydrogeneration facility would not adversely impact the primary uses and characteristics of the area. Montana will have to deal with these same considerations in deciding how to protect the natural and cultural features it deems most important. In the absence of a definitive policy for assigning "importance" to the many factors required to select candidate areas (or to rule out other areas not specifically protected by statute), California may not make specific site area designations and instead may concentrate on developing sound criteria to guide the utilities in their specific site selection activities for given plant types

FACTOR MATRIX

Figure III-2

FACTOR	Statewide High Avoidance: Resource	Statewide High Avoidance: Hazard	Statewide Significant: Opportunity	Statewide Significant: Undefined?	[illegible]	PRC 25527: [illegible]	PRC 25527: [illegible]	COMMENTS
1. Prime Agricultural Land				●				
2. Agricultural Preserves					●			
3. Badlands					●			Proposed addition - public
4. Parks and Wilderness Areas	●					●		
5. Coastal Zone								*
6. - Coastal Scenic Areas	●							*Proposed addition - staff
7. - Coastal Non-scenic Areas					●			*Proposed addition - public
8. - Coastal Industrial-Urban					●			*Proposed addition - public
9. Coastal Reserve Areas					●	●		*
10. Desert and Semi-arid Areas					●			Proposed addition - public
11. Scenic Highways					●			
12. Existing Energy Facilities					●			*
13. Military Bases								
14. - Active Military Bases					●			Proposed addition - staff
15. - Bomb and Missile Target Areas and Test Areas		○						Proposed addition - staff
16. - Surplus Military Property			●					Proposed addition - staff
17. State and National Forests				●				
18. - National Forest Wilderness & Primitive Areas	●					●		Proposed addition - staff
19. Historical, Archaeological and Cultural Resources								Delete - see below
20. - Designated Historical, Archaeological & Cultural Areas					●	●		Proposed addition - staff

*Proposed Special Study

and designs (Nichols 1976).

It is unclear how the commission will eventually interpret its legal directive to identify candidate site areas. Recent information indicates that the site selection methodology will not be implemented beyond the delineation of broad statewide criteria and equally broad identification of "areas of importance" for any type of development activity. It appears that a major factor in this decision is the problem of coordinating all of the various levels of administrative and regulatory agencies and their accompanying policies in a manner which would permit the regional siting process to occur. Although the commission has the legal mandate to command this type of coordination, it may not be exercised in accordance with the selection of candidate siting areas.

The long-range planning advantages of combining comprehensive energy demand research and conservation activities with the energy facility siting function are quite obvious. An administrative arrangement of this type may not be organizationally feasible for the immediate future in Montana. However, this approach should be seriously evaluated as a long-term planning option.

The relationship between long-range facility siting and land use planning is another complex area which must be considered. Montana presently does not have a comprehensive land use plan and most land use responsibility currently rests with local government. Land use planning is inherently a process of balancing competitive needs; siting decisions should be closely coordinated with this process. California has not yet achieved this coordination, but as was mentioned above, its energy commission has the authority to deal with the problem as well as specific authority to set land use standards to be applied to the design and operation of energy facilities.

G. Analysis

The six state siting processes reviewed in this section provide a basis for discussing the choices, opportunities and problems the State of Montana must consider in developing its own siting process. This report has been based upon the assumption that Montana must become involved in long-range energy planning and energy facility site selection if optimal decisions are to be made in the future. A large portion of this report is concerned with the development of siting criteria and application of the criteria to classify areas of the state in terms of their suitability for siting. However, it must be emphasized that this activity cannot occur in isolation. It is dependent upon state involvement in the projection of long- and short-term energy demand and the subsequent determination of the need for new facilities at a point in time which will allow optimal site planning to occur. It is also dependent upon technological developments in plant design and size and the potential future reduction of many types of adverse environmental impact. Further, in a fundamental sense, site planning depends upon interagency coordination, public involvement, and availability of information.

One long-term aspect of energy planning which the State of Montana must define is the level of involvement it will have in the determination of need for future energy facilities. The States of California and Maryland have established a legislative framework which, in theory, allows them to assume, or at least jointly occupy, the position traditionally held by the utilities in forecasting energy demand. In a less broadly defined sense, Oregon and Washington also are making independent analyses of the information included in utility long-range plans.

These four states have had varying success in fulfilling their planning roles, and in California in particular, the process is so new that a definitive evaluation cannot yet be made. Both Maryland and California are characterized by extremely well funded programs which can provide broadly-based expertise in making defensible energy demand projections. Recent information from California indicates that, for the present, projections will be developed for general regions and service areas in the state, but that there will be no attempt to specify the number of megawatts required (Brown 1976). Maryland has apparently been able to meet its responsibility for developing an on-going, ten-year plan which delineates all future energy facilities needed for the ten-year period. However, the exact relationship or differences which have existed between this plan and the information submitted by the Maryland utilities is not known.

Energy demand forecasting is not the major concern of this report. However, a state cannot adequately prepare for the siting of future energy facilities unless it possesses the best available information for determining the amount of energy which will be needed at a future point in time. Utility long-range plans have been the chief source of this information, but general experience has shown that due to differing objectives and responsibilities, the utilities and the states are frequently in disagreement on many aspects of forecasting methods and results. The complexity involved in making forecasts compounds this problem. Further, forecasting "formulas" utilized in the past have proven increasingly inadequate for preparing forecasts which accurately reflect changing energy consumption patterns and the increased effects of energy conservation measures over the past four or five years. As a result of these changing trends and related economic uncertainty, utilities have had to shorten the planning periods or "lead times" allowed for developing new energy facilities. At the same time, the states have had to become much more involved in the formulation of energy projections in order to avoid being "surprised" by sudden, legitimate needs for new facilities which could confound long-range site planning efforts. The primary means of avoiding this type of situation is to insure state access to energy supply and demand data, conservation data and research concerning alternative means of meeting energy needs.

The level of state involvement in energy demand forecasting outlined by the Maryland and California laws may not be essential to insure adequate state access to necessary information. For example, Oregon and Washington conduct independent demand studies with relatively small staffs and budgets. California law requires all utility demand projections to be formulated according to a methodology developed by the state, although the utilities may submit additional information using their own processes. This provision may potentially simplify the state's analysis of the utilities' projections and it could alleviate some of the need for state

duplication of utility forecasting activities. A similar provision in Montana's law could greatly enhance the state's position in dealing with energy demand information while a broader program of state involvement in this area is being considered.

The utility long-range plans required by the siting act are presently a principal source of energy demand information available to the State of Montana. Although the general national uncertainty surrounding accurate determination of future need for energy facilities may not be easily overcome, the information included in utility long-range plans must be accurate to the greatest extent possible. The problem of insuring accuracy could be handled by adding a special enforcement clause to the Major Facility Siting Act which would specifically apply to the long-range plans and would provide the state with some recourse if information in the plans is found to be incomplete or falsely presented. Also, maximum interaction should be encouraged between the state and the utilities in formulating energy demand forecasts and in sharing all types of relevant information. It is imperative that the State of Montana remedy its present position of determining the need for a proposed facility solely on the basis of the individual application evaluation process mandated in the siting act. The state must be intimately acquainted with the potential need for a facility within a time frame that is equivalent to the applicant's initial planning activities.

A statewide siting study and development of site criteria are activities which respond to the problem situation described above. If the state can provide an informational and geographical framework to guide the utilities' initial facility planning and siting studies, the application and evaluation process can be streamlined and will permit much more effective use of the evaluation time period presently provided by the siting act. This front-end involvement would certainly be preferable to the state's present reactive position in the siting process.

The scheduling of site criteria development and a subsequent statewide siting inventory must be clarified. A siting study cannot proceed until appropriate criteria have been developed. The following section of this report discusses the types of problems and issues which must be considered in this process. Criteria, in turn, depend upon the type of study mandated by the state's siting legislation.

The six states analyzed in this report essentially represent three siting inventory alternatives and one situation which is basically comparable to Montana's present siting process. This latter example is the State of Washington. In the absence of a state mandate to conduct a siting inventory, an inventory was initiated by the publicly-owned Washington utilities. It is questionable whether such a study would provide an appropriate basis for state decision-making; however, the preferred site selection criteria and the methodology used in the Washington study should be examined for potential applicability to a state-initiated study in Montana.

The three inventory alternatives mandated in the other five states' siting legislation may be characterized as follows:

Maryland	Responsible for selection and acquisition of sites.
California Minnesota North Dakota	Responsible for designation of specific suitable sites.
Oregon	Responsible for designation of suitable and unsuitable areas.

The characteristics of the siting inventories conducted in each state are summarized in the table on the following page.

Maryland's unique siting process is based upon a program of extensive siting research and an extremely expensive commitment to site-specific studies. Appropriate funding is a key element which must accompany a program of this type. Maryland's land use situation is a major factor underlying its siting process. The competition between varying types of land uses is so intense on a statewide basis that the state felt it necessary to acquire specific sites, especially sites representing the least total adverse impact to surrounding areas, in order to preserve them from other conflicting land uses or development before they can be utilized for future energy facilities. Montana may never be characterized by this type of problem. The expense of conducting the site-specific studies required to justify the direct selection of sites may not be warranted. Also, in this type of siting process, the state is ultimately responsible for regulating activities at the sites it selects. Further, this approach would require the state to assume some responsibility for the design of future facilities in order to select appropriate sites.

Maryland's approach would not be feasible for Montana without entirely reconstructing the existing siting legislation and creating a new funding mechanism, presumably similar to Maryland's and California's surcharge on consumer power bills. Also, this type of siting process might not be necessary to insure that optimal sites are chosen for energy facilities in Montana.

At present, California, North Dakota and Minnesota are legally responsible for designation of specific suitable sites. Thus far, these states have not fulfilled this responsibility. A review of the subsections for each state will show that North Dakota has completed an inventory of unsuitable areas based upon exclusion/avoidance criteria at the county level and is presently considering amending its law to require only this level of study; Minnesota completed an inventory which reached the level of identifying candidate site areas from larger areas not designated unsuitable. Due to problems with basic resource data and problems of coordination between various state agencies, the study was not accepted. Efforts to resolve disagreements and develop revised criteria are presently on-going; California developed a regional process for identifying candidate areas, but the anticipated problems involved in achieving interagency coordination for a more detailed study have, for the present, halted this process at the point of developing general statewide criteria which will identify broad areas of "importance" to siting and other forms of development.

Table III-1

CRITERIA DEVELOPMENT AND SIT
INVENTORIES CONDUCTED IN OTHER ST ES

	OREGON	WASHINGTON	NORTH DAKOTA	MINNESOTA	MARYLAND (5)	CALIFORNIA
Siting Study Objective	Identify unsuitable areas for siting nuclear, fossil-fueled and geothermal power plants.	Identify suitable sites for thermal power plants.	Identify unsuitable areas for siting power plants and electric transmission facilities (1).	Identify candidate areas for siting fossil-fueled and nuclear power plants (1)(2)	* Identify three specific sites in Maryland's eastern region. ** Develop process to identify candidate sites for future study in Maryland's western region.	Develop process to identify candidate areas for siting. (1)(2)
Responsibility for Criteria Development	Task force appointed by chairman of siting council. (3)	Washington Public Power Supply System and Woodward-Clyde Consultants, San Francisco.	Citizen advisory committees appointed by state siting agency. (3)	Citizen advisory committee appointed by state siting ag agency. (3)	* State power plant advisory committee. (3) ** Federal Nuclear Regulatory Commission and Oak Ridge Nat'l. Laboratory, Oak Ridge, Tenn.	State facility siting division. (3)
Mapping and Assistance	Mapping by state personnel.		Mapping/consulting by TPI, Inc., Bismarck.	Mapping/consulting by EDAW, Inc., San Francisco.	* Mapping/consulting by Rogers and Golden, Inc., Philadelphia; Alan Mallach Assoc.	Mapping/consulting by EDAW, Inc., San Francisco
Time Schedule	Task force appointed -- June 1972. Results published -- July 1974. Results adopted in siting rules and regulations -- December 1974.	Study initiated -- Mid-1974. Candidate area results published in December 1975. Selection of nine potential sites -- Fall 1976.	Committees appointed -- June 1975. Criteria adopted -- December 1975. Results published -- July 1976.	Criteria development -- December 1974. Results published June 1975.	* Consultant contract -- June 1976-June 1977 (period may be extended). ** Process development (Spring 1974 - November 1976) State must select specific criteria and apply the process (1977)	Study initiated by state -- October 1975. Process results published -- September 1976.
Cost	$50,000 (reflects use of existing data and state personnel, includes task force per diem costs) (Woods 1976)	$900,000 (reflects cost of selecting potential sites for further study. (Tillson 1977)	$234,000 (total consultant fee, includes $80,000 for mapping; does not reflect committee's expenses or state assistance) (Zink 1976)	$106,500 (consultant and administrative fees, includes $81,000 for mapping; does not reflect committee expenses or state assistance; used existing data) Bowie 1976)	* $270,000 (amount of one-year contract; in addition to power plant related studies, reflects cost of analysis for coastal zone facilities and other activities; does not reflect committee costs) (Brush 1976) ** Cost information unavailable.	$115,000 (reflects cost of criteria development and study process; no mapping involved). (Brown 1976)

(1) Siting law presently requires identification of specific sites.
(2) Study process was designed for eventual use in identifying specific sites.
(3) Assisted by input from public meetings.
(4) All study costs are broad approximations which must be interpreted in terms of the explanatory comments included for each state and which would require further investigation if precise estimates are needed.
(5) Maryland has conducted two separate siting studies; the descriptions of these studies are differentiated by (*) and (**), respectively.

Oregon's law calls for designation of areas suitable and unsuitable for siting. This designation was accomplished through a broadly defined, regional inventory using very general criteria. It is important to note that Oregon considers its unsuitably designated areas closed to siting. North Dakota's existing situation is quite comparable to Oregon's even though the legal mandates of the two states are presently quite different. The actual prohibition of siting in an unsuitable area may not be necessary if a state's unfavorable consideration of applications for sites in such areas is guaranteed. This topic will require further legal analysis before Montana's specific course of action can be determined.

The relative uncertainty presently characterizing the siting processes in Minnesota and California must be carefully considered. Both states are questioning the advisability of actually identifying specific suitable sites for all the reasons mentioned above in relation to Maryland, as well as the attendent adverse effect this type of designation can have upon an area before development occurs. The disadvantages of direct site selection may, in fact, outweigh the advantages.

Both Minnesota's and California's siting agencies are apparently in favor of carrying the siting process as far as identifying candidate siting areas from a more general designation of suitable and unsuitable areas. As noted previously, this would involve the application of preferred siting criteria (i.e., criteria designating geographic elements favorable to siting) to areas not designated unsuitable in a more general, regional study.

This step must be evaluated at both theoretical and practical levels. The more specific the criteria and size of area to be considered, the more precise the data requirements and the more intricate the required coordination between various regulatory and administrative agencies. In a practical sense, these two considerations are responsible for most of the problems in both California and Minnesota. It is essential to note that Montana will be confronted by these same concerns in conducting any type of siting inventory. On a theoretical level, there may be advantages to designating suitable candidate siting areas; however, the same legal problems involved in closing some areas to siting would apply if the intent, in this instance, was to permit siting only within candidate areas. If, on the other hand, candidate areas primarily are intended to serve as strongly recommended geographic guidelines for future siting, it appears that the same objective could be served by designating areas unsuitable to siting and developing a definitive set of "preferred" site criteria which would guide a potential applicant's efforts to find a specific site within areas not designated unsuitable. This latter alternative could be considerably less costly to the state in the long run, while essentially providing applicants with preferred site criteria to consider in combination with specific plant designs in locating a specific site. Additionally, candidate area selection could be authorized at some future time after an acceptable inventory of suitable and unsuitable areas has been completed.

Oregon, North Dakota and Minnesota assigned responsibility for criteria development to an independent task force composed of members of the public at large and representatives of special interest groups and governmental units. Montana should consider a similar arrangement, although it would also be

important to insure that the task force contain members with expertise in the various disciplines of concern to siting. A task force would require advisory assistance from the state siting agency and all other agencies having related concerns or expertise. Also, the siting agency could assume responsibility for actual application of the criteria in data gathering and mapping activities, although consultants carried out this responsibility in North Dakota, Minnesota and Maryland. However, potential future conflicts of interest, especially within state regulatory agencies will be avoided if the task force is responsible for criteria development.

The overall objective of comprehensive state involvement in long-range energy planning and facility siting can be effectively instituted through the development of siting criteria, completion of a siting inventory, and improved state access to and analysis of data required for energy demand forecasting. However, these measures involve long-term projects which may not be completed in time to meet short-term planning needs. The discussion of the six states included in this section has revealed at least one type of provision which could be immediately included in Montana's siting act to permit earlier state and public review of utility facility planning and siting-related activities. The Oregon, North Dakota and California laws require that a potential applicant must file a notice of intent to file an application for a certificate to construct a major facility at least one year prior to filing the application. The notice must disclose the specific site location being considered for the facility. The provision is not intended to extend the time required for state evaluation of the facility. Rather, it provides a readily available means of insuring public awareness of site location plans. It also provides the state and the applicant the opportunity to confer on the suitability of a given site and identify problems as well as areas of agreement prior to the actual application and evaluation process.

Most of the states discussed in this section have featured some type of public involvement in the siting process which has gone beyond public hearings and gathering of public comments on siting studies and related activities. In North Dakota, Minnesota and Maryland, public involvement has specifically been incorporated in the form of siting advisory committees which assist the siting agency in the consideration of individual facility applications. The input from these committees may be helpful in identifying problem areas. The committees generally are composed of representatives from legally specified interest groups and occupations as well as the public at large. The public involvement concept is essentially carried over to the creation of special task forces to develop siting criteria rather than assigning this task to state officials. A task force should also be responsible for providing for public review and input into its activities. Montana should consider adopting a general policy encouraging public involvement of this type.

IV. CRITERIA

At its most basic level, the process of energy facility siting depends upon and is defined by criteria. "Criteria" is a rather broadly defined term which refers to the complex inter-relationship of policy delineations and basic data needed to compare and evaluate geographic areas in terms of their suitability or unsuitability for siting. All of this information must be identified and categorized in some comprehensive system. Several ways of classifying or conceptualizing siting criteria will be discussed below.

Site criteria are based upon policy or legal designations which establish the general relative importance or status of some natural or cultural environmental element and infer the relationship of that element to an activity such as facility siting. For example, air quality standards and policies requiring minimization of adverse environmental impact dictate the need to consider air dispersion and meteorological characteristics in any area being evaluated for siting. "Meteorology" thus would be included in the criteria list for a siting study, but would require further definition and refinement to reflect the objectives and level of detail required by a specific study. It must also be noted that meteorological information, as well as information from any other field, acquires meaning for a siting study only when considered in terms of a total relationship with other environmental elements and the impacts of an energy facility. It is not surprising that most elements which must be considered in locating an optimum site are regulated through some type of legislation or policy. Therefore, whether one develops criteria which will identify areas favorable to plant siting or criteria which will identify unsuitable areas, a legal or policy base is almost always present.

This suggests one way of organizing criteria. Some land uses, by legal definition, absolutely prohibit the siting of any type of energy facility in an area. The most common example of this type is a national park or some other specifically protected area of natural, scenic or historic significance. Other similar types of areas, such as state parks or recreation areas may have less stringent legal protection or more vaguely defined policy status and may not be absolutely closed to siting but remain highly incompatible with this type of activity. These various types of resource areas may be grouped in two categories called "exclusion" and "avoidance" area criteria, respectively. Other types of land use or capability (prime agricultural land, for example) may not have a legally defined relationship to activities such as siting, but through policy delineation, these land areas may be included in an exclusion or avoidance category. Although these types of land uses are most representative of exclusion/avoidance criteria, areas with characteristics which would adversely affect a facility may also be so designated. An example of this type would be an active fault or earthquake zone.

Exclusion/avoidance criteria represent a conceptual means of classifying information for purposes of declaring areas unsuitable to siting. However, this objective could be reversed to reflect resource information in a way that would define areas of optimum suitability for plant siting. In this instance, resource and land use characteristics would be viewed as opportunities or constraints. Opportunities might include such factors as adequate water availability or proximity to existing transportation corridors. Constraints would be any of the types of factors included in exclusion/avoidance criteria. Additionally, criteria could be developed which would establish the characteristics preferred sites should possess. These criteria might not be directly included in the siting inventory but could serve as guidelines to future applicants for specific sites.

The classification of criteria may vary considerably in relation to different types of energy facilities. Fossil fueled, nuclear and hydroelectric generating plants and various types of conversion plants produce different types of impacts upon the environment. They also present different demands upon a site in terms of water requirements, foundation suitability, etc. Likewise, the siting of transmission facilities presents a completely separate set of concerns. An inventory of suitable and unsuitable site areas must take these differences into account and, thus, area designations will vary for the different facility types. Since the specific requirements and specific impacts of a plant are dependent upon specific design characteristics and pollution control technologies, inventory studies are often based upon representative characteristics, such as for a "typical" 1000 megawatt plant. However, a broad inventory to designate suitable and unsuitable areas would probably not require this level of detail.

Another criteria consideration concerns the specific level or degree of measurement which is applied to any given factor. The criteria to be included in a study or inventory will depend upon the objectives and specificity of detail required. For example, designation of suitable and unsuitable areas could be accomplished through use of very broadly defined criteria which might consider the general characteristics of entire air sheds or major stream drainages, assuming that data availability would permit inclusion of these two factors. On the other hand, a study designed to identify candidate siting areas or specific sites would require much more detailed units of measurement to reflect the air dispersion characteristics of specific areas or the flow characteristics of a specific stream within a certain number of miles from a potential siting area.

As units of measurement become more specific, two requirements become apparent. First, the data needed to meet the objectives of the study must be available at a scale and level of accuracy which will permit reliable determinations to be made. If the data are not available, compromises in the criteria become unavoidable. Second, there must be a methodology for assigning the units of measurement and subjectively weighting the various criteria for purposes of trade off and comparison between areas. The methodology must be capable of dealing with the level of detail required to meet the study objectives.

The credibility of any siting study is based upon the defensibility of its criteria and the accuracy of the basic data involved. Data and methodology-related matters are discussed elsewhere in this report. The defensibility of

criteria is a separate matter which is largely dependent upon supportive policy delineations. The results of a statewide siting study can be expected to stir controversy in terms of public opinion as well as impacts upon many separately administered concerns. The decision to include some criteria and exclude others must ultimately rest with the best judgment of the task force or agency responsible for the siting inventory. The inventory results are obviously most secure if there is some provision for their legal inclusion in a state's siting rules and regulations after proper public and governmental review and modification procedures have been completed. Nevertheless, the defensibility of the criteria depends upon their basis in official state policy. Therefore, the more that a study can be guided by such existing policy, the more secure its results will be. The following paragraphs elaborate upon a few siting-related policy issues which the State of Montana may be called upon to consider in the future.

Two issues of major concern in Montana and other states of the Great Plains are the alternative uses to be applied to a limited water supply and the protection or status to be accorded to agricultural and timbered lands in the face of mounting pressure from other land uses. These matters have received considerable attention in recent years and the amount of reliable information has increased proportionately. However, Montana has no specific policy concerning the siting of energy facilities or other industrial facilities in relation to surface and groundwater availability except for protecting the status of existing water users. This situation may be partially resolved by current water policy-related activities, but a statewide siting study may eventually be required to address this issue as a specific siting problem. If areas or water drainages with a questionable carrying capacity for future, non-agricultural uses should be avoided, this should be a specific policy decision. Likewise, the importance of agricultural and timbered land should be addressed, perhaps in terms of the land's productive capability. As was discussed in Section III, some states have taken this step by including such land in an avoidance criteria category or by setting a limit upon the number of acres which may be considered for alternative uses within a given size study area.

Another important policy issue concerns the siting of energy facilities near urban areas as opposed to siting in remote, sparsely populated regions. The environmental, social and economic trade-offs involved in such decisions have been well documented. However, this issue exposes one of the most critical gaps in existing policy and research. Most elements of the natural environment have a well-established basis for protection from adverse impacts created by human activities. The basis for protection of certain cultural, economic and social elements is much less well defined. No general policy has been established to identify the elements of human life style and cultural carrying capacity which should be protected. Also, mechanisms for making accurate predictions of future social and biological impact in areas slated for development have been generally lacking. These types of policies and analysis techniques must be developed if optimal siting decisions are to be made in the future.

The issue of urban vs. rural siting involves many arguments inherent to the related issue of siting near load centers vs. siting near fuel supply districts. These choices naturally pose separate problems for the different types of energy facilities. The safety-related aspects of nuclear plant siting may argue against proximity to population centers. For fossil fueled plants, however, economic

considerations and impacts upon human health must be weighed against the minimized environmental- and community-related impacts associated with more urban locations. Also, the effects of transmission lines upon other land uses and questions of reliability and efficiency require consideration.

The siting of energy facilities at "dispersed", single facility sites must be compared with the potential development of energy parks or multiple facility sites in the future. Although a few studies have considered this issue, it appears that more information is needed regarding the potential impacts of clustered facilities before definitive policies may be formulated. Additionally, the state would need to consider a general size (in megawatts) for an energy park before designing the "carrying capacity" studies which would be required to identify potentially suitable siting areas. The water and fuel requirements of clustered facilities coupled with the technological problems of meeting various pollution standards may effectively eliminate most siting options. Further, policy resolution of the load center vs. mine mouth siting issue and a definition of need for future facilities in Montana may render clustered facility siting a moot consideration. Also, long-term commitments to multiple facility development would require extremely careful planning to insure flexibility in terms of changing energy demand conditions and incorporation of new technologies.

In addition to the above policy considerations, there are other technical and policy-related topics which strongly affect siting and the development of appropriate criteria; however, these topics require detailed study before specific siting recommendations can be formulated. Included in this category is the transboundary effect of siting facilities near interstate or international boundaries or in any location which would impact a neighboring region under separate governmental administration. While it appears unrealistic to place arbitrary limits upon this type of siting, many procedural policies should be adopted to insure the fullest possible interaction between all potentially affected parties at the earliest possible stage of project planning. Further, mutually acceptable principles of environmental protection and minimization of all types of adverse impact should be negotiated to guide future development plans.

Another topic requiring technical investigation is the synergistic effect of siting two or more types of energy generation, conversion, or industrial facilities in close spatial proximity. This topic will acquire additional importance if multiple facility siting is considered in the future. Also, a separate, but related concern involves the feasibility of recycling conversion by-products and utilizing waste heat. Both of these concerns would involve concentrations of facilities in a single area, and as related to siting, they would require carrying capacity studies to evaluate specific locations. These studies should also be applied to existing sites. It must be noted that many technical aspects of minimizing synergistic environmental impacts have not been acceptably resolved. Therefore, this problem requires further analysis of policy options as well as technical research.

The siting of an energy-related facility involves indirect impacts by providing potential encouragement to various future types of industrial development.

This must be considered in terms of a specific geographical context as well as general economic influence. Various aspects of community and land use impact are obviously involved, as is the overall question of future economic growth. It is clear that some sites or site areas are far better equipped to handle indirect impacts than others. It is also clear that the choice of location for a facility will affect the magnitude of resulting economic activity. Although this problem already must be considered in evaluating specific facility applications under the siting act, Montana presently does not have a definitive policy for dealing with it as a site planning problem. This is also true of the other concerns briefly discussed above.

Several other examples of siting criteria which may require policy guidance and which might be formally included in the siting rules and regulations upon completion of a site inventory are listed as follows (stated as preferred site characteristics):

(1) Permits maximum use of existing generation, transmission and transportation facilities.

(2) Permits recycling of conversion by-products and significant energy conservation.

(3) Permits minimum disruption of local communities.

(4) Avoids destruction of vegetation types and wildlife habitat which are unique or of special significance to an area.

This discussion has not been intended to provide specific site criteria recommendations for a Montana siting study. Rather, it is expected that this discussion will serve as a preliminary outline of criteria topics and organizational options which should be considered in designing a siting study. In conclusion, the two most essential goals of criteria development must be (1) the identification and subsequent assessment of the factors most important to siting, from both "avoidance" and "preferred site" points of view, and (2) the insured credibility of the study results. The discussion of other states' siting activities presented in Section III may provide useful guidance in meeting the first goal. Also, the widest possible range of interests and areas of expertise should be consulted for criteria development.

In terms of the second goal, the importance of a strong policy base for all criteria included in the study cannot be over-emphasized. Therefore, the siting agency or task force should be authorized to investigate or commission the outside investigation of the policy issues mentioned in this discussion, as well as other siting questions requiring further study. Also, criteria development must proceed in terms of the accuracy and reliability of available data.

A very useful by-product of this process should be the identification of data categories as well as geographic areas within Montana which require further research and data collection efforts before the existence of an adequate statewide resource data base can be claimed.

V. RESOURCE DATA ASSESSMENT

As noted in the preceding section of this report, a statewide siting inventory will depend upon numerous types of basic resource data which must be categorized and defined in terms of site criteria. It was further noted that the specificity and types of criteria are determined by the overall objectives of the study and that studies designed to delineate areas unsuitable for siting would require more general criteria and more generalized data than a study designed to identify specific sites or candidate site areas. Although criteria can be established to indicate the types and specific levels of detail of environmental elements which should be applied to a siting inventory, the availability of data will determine the degree to which these criteria can be applied in the immediate future. If certain data are not readily obtainable at a level of accuracy or reliability sufficient to meet criteria specifications, compromises in the criteria may be unavoidable.

This raises an important point. The generation of new resource data is an extremely expensive process which involves extensive field studies, analysis of remote sensing and aerial photographs, and detailed comparisons of various existing maps and other data sources. The development of siting criteria will unquestionably reveal many "gaps" in Montana's existing resource data base which must be filled if siting activities, land use planning and resource management efforts are to be improved in the future. In this sense, the siting study can be expected to provide some specific direction for future data collection efforts. However, it is unlikely that the scope of the siting study will permit incorporation of a major effort to generate new resource data. The time and expense involved would be too great. Since the funding required for generation of new data is very substantial, every effort should be made to secure federal cooperation and support as well as a major funding commitment from the state. This activity should proceed separately from the siting study and most optimally, it should be based upon the results of the study as well as extensive interaction with other users of resource data in the state who could help identify the most critical gaps in existing information.

A preliminary assessment of certain categories of Montana's existing resource data was undertaken to provide background information for this report. As a result, some general observations and comments may be made. For a number of categories, adequate data exist on a statewide basis to allow formulation of criteria which could be utilized in a regional study designed to designate areas unsuitable for siting. This is especially true of many types of human resource data such as population and demographic characteristics, and economic and social data. Coverage of natural resource data is generally not as comprehensive because both the quality and quantity varies considerably between categories and between various regions of the state. For example, baseline surface

water quality data has been collected for nearly all of the perennial streams in the state. However, there is a critical lack of information regarding groundwater quality (Karp 1976). Wildlife distribution and fisheries data, especially for the major game species, is generally available on a statewide basis, but this type of inventory information may not be applicable to a siting study unless it conveys something about a particular area or region which would be adversely affected by siting. For example, critical areas, habitat areas of exceptional quality and areas of high population density probably should be included in "avoidance" type criteria. However, this type of information may not be included in general species distribution data.

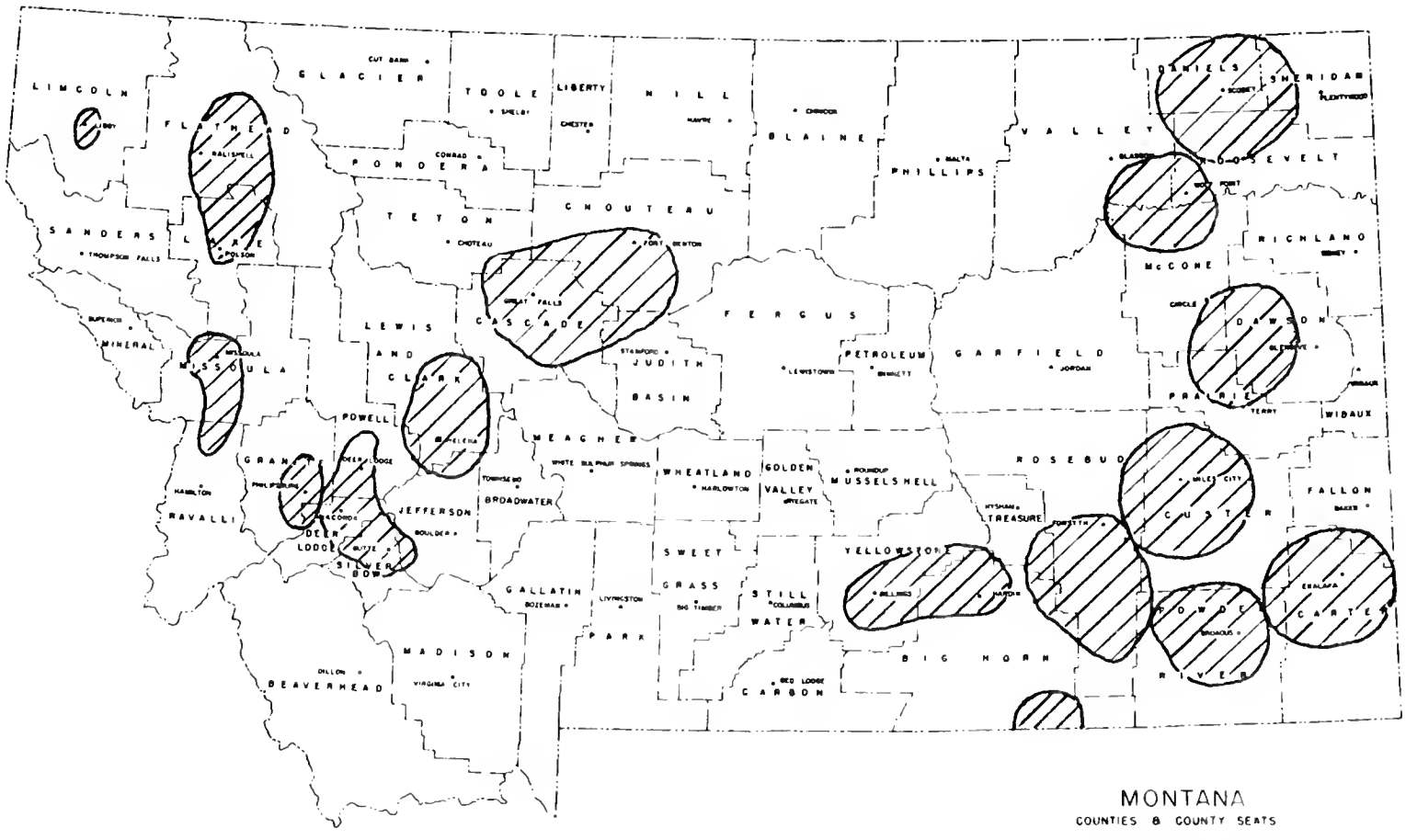
A major problem is evidenced in attempting to assess the general availability of land use and land capability data and vegetation types data as well as most wildlife information. A great deal of data exist, but very few parameters or classifications of information within these general data categories have been uniformly covered on a statewide basis. Much of the information has been compiled or mapped by different agencies or study teams in different regions using different mapping scales. Also, some of the data are more up to date than others.

For some data categories, such as air quality and meteorology, existing information could be generalized at a regional level, but the following two figures indicate the areas where studies adequate for specific types of environmental assessment actually have been completed. A considerable amount of new data would obviously be required if a siting inventory is conducted at this level on a statewide basis.

It generally appears that criteria based on existing data could be developed for a regionally oriented siting study. The experience provided by a similar siting study conducted in Oregon supports this conclusion. However, this statement must be qualified by noting that it may be impossible to map ideal criteria for each data category which should be included. Lack of accurate data or general lack of coverage for some data categories may require modification of some criteria or potential elimination of other criteria. These decisions will be a major responsibility of a siting task force.

The difficulties involved in making an accurate assessment of existing natural resource data have implications which extend far beyond the needs of a statewide siting study. Every major natural resource study conducted in Montana is confronted with the demanding task of gathering fragmented existing data and either combining it to form a comprehensive "picture" for a given geographic study area or commissioning a new study to supply missing information or supplement inadequate existing information. The fact that most resource studies have different objectives and require different levels and combinations of data compounds the problem by requiring that similar data inventory processes be repeated over and over.

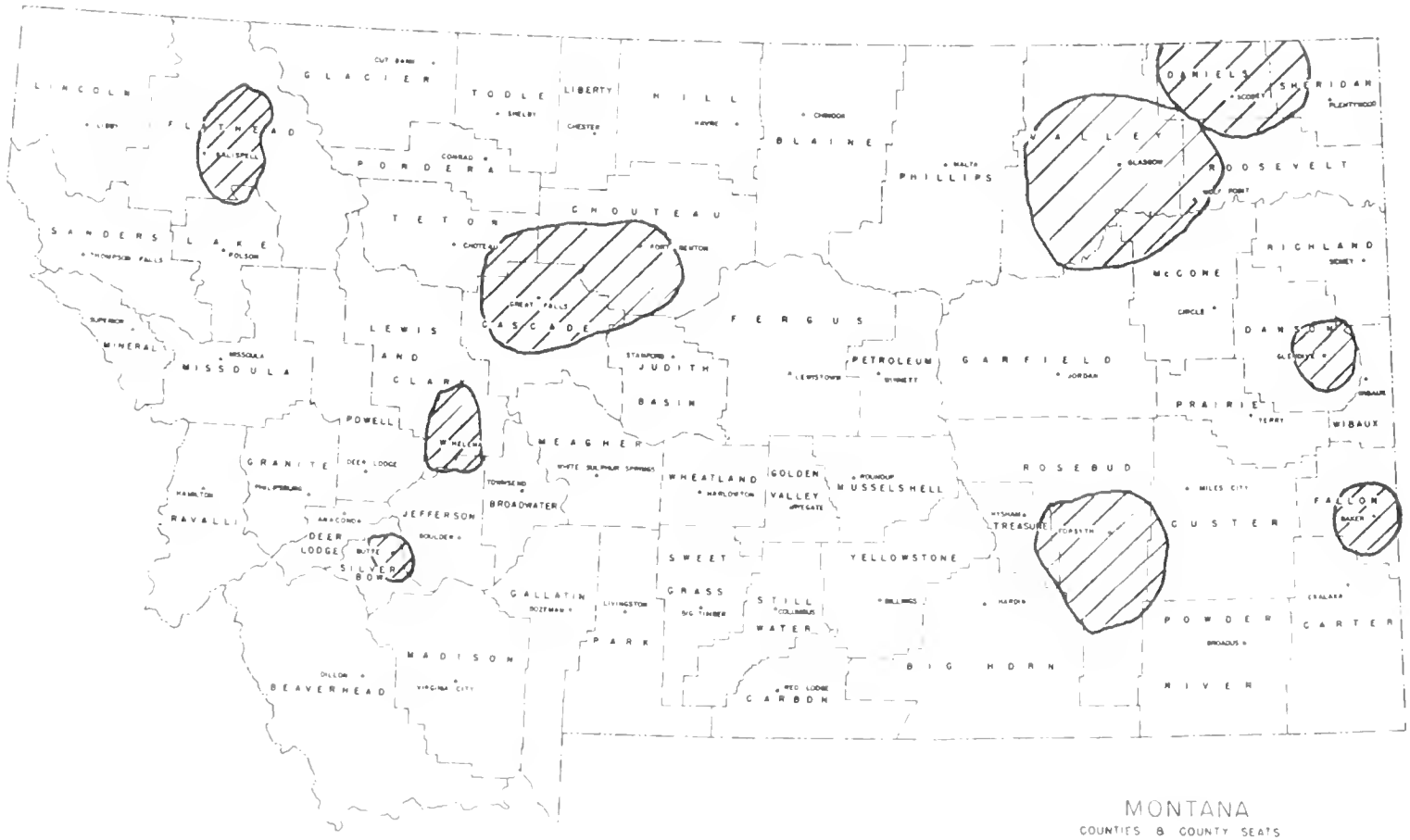
Decision-making and regulatory agencies must remain free to initiate studies and data collection efforts designed to meet their specific needs and responsibilities, but better coordination and standardization of existing data and a mechanism for the cateloging and storage of both new and existing information would clearly represent an improvement of the present situation. This type of coordination makes sense, but it will not be achieved without assigning specific authorization and funding to a specific agency, office or advisory unit.



MONTANA
COUNTIES & COUNTY SEATS

Areas where sufficient air quality data is available for environmental assessments including particulate data and sulfur dioxide data

Figure V-1



MONTANA
COUNTIES & COUNTY SEATS

Areas where sufficient meteorological data is available for environmental assessments including stability data, inversion data, upper and surface wind data and other significant meteorological variables.

Figure V-2

Such a designation would require creation of a data assembly and storage system. In turn, the establishment of this system would require many specific decisions, including:

(1) Identification of potential system users and, to the greatest degree possible, delineation of each user's major information needs (i.e., data categories, scale and level of detail, as well as specific operational needs).

(2) Definition of mutually exclusive data categories for storage purposes.

(3) Provision for double filing of data in both its original study format and in categories developed for the overall storage system.

(4) Setting of data accuracy standards.

(5) Development of uniform mapping standards to guide future resource data collection activities to the greatest extent possible.

Several principles of operation for this type of system are immediately evident. The system should be designed to accommodate the widest possible range of user needs. Therefore, it should be designed by those users to the greatest extent practicable. One administrative option which would provide this user input is the creation of a steering committee or board (made up of potential system users) with directive powers and oversight responsibility for the activities of the agency or office assigned to develop and maintain the system. It is assumed that other on-going efforts to improve the mapping of resource data in the state could be coordinated with the development of this system.

The potential designation of one agency to be responsible for assembly and storage of resource data could have an especially significant and beneficial effect on the statewide siting study if the authorization for these two activities is granted within a similar time frame. A data assembly and storage agency as well as other state agencies would be able to provide important assistance to the criteria development effort in providing advice concerning the availability of various specific types of data. Additionally, as noted previously, the siting study could be expected to uncover specific data needs which could give direction to future data collection efforts. If funding is secured, these efforts could be designed primarily to improve the general resource data base for all users rather than solely serve the needs of a single study.

VI. DATA SYSTEMS

A statewide siting inventory and most other types of resource planning and management activities require the assembly and analysis of a considerable volume of resource information. Efficient execution of this task involves two complementary data handling requirements. First, a system must be established to coordinate the assembly and storage of basic resource data (i.e., soils, vegetation types, slope, land use, etc.). As was discussed in Section V, this system must be based upon clearly defined, mutually exclusive data categories, but it must be flexible enough to meet the needs of a wide range of users.

A second requirement concerns the availability and coordinated management of computer hardware and software capabilities needed to efficiently store, analyze and otherwise manipulate all types of spatial data on a statewide basis for decision-making purposes. This latter requirement will be the principal concern of this section of the report.

It is important to note that this requirement can be fulfilled by a single, well-designed computer system, although specialized software not needed for data storage would be required for data manipulation and analysis. The use of a system or systems to coordinate data storage and data manipulation functions is a management concern which should not be confused with system capabilities.

The following discussion of automated data management must acknowledge a set of concerns entirely separate from system capability analysis. These concerns are concentrated upon a general lack of understanding by many decision-makers and other potential users of the services an automated data system can provide (Salmen 1973). Also, automated data systems may be viewed with some suspicion, partially because of system-related barriers, such as complex programming processes, which only system programmers and designers can operate. Additionally, decision-makers may not adequately perceive the complexity or volume of information required to assess various types of planning problems. As a result, inappropriate types of responses may be made.

These concerns are a major problem because justifications and explanations of data systems, which may seem self-evident on an empirical basis, must be carefully prepared and presented to potential users if the systems are ever to be utilized. The need for improved communication and presentation of system capabilities will be discussed in subsequent portions of this section.

A. System Components

A general discussion of the computer system components and capabilities needed to assist resource management and planning efforts is presented below. This discussion is exerpted from a 1975 Montana State Government publication entitled "ERGIS Data Bank for Land and Resource Utilization" (DNR&C 1975).

The major operations involved in assembling a data system include: (1) input material analysis; (2) input device selection; (3) storage format determination; (4) storage device selection; (5) output format and device selection; and (6) data manipulation requirements. These operations and their relationships are graphically presented in Figure VI-1 on the following page and are described as follows:

Input Material Analysis

The source and format of input materials determine the data input hardware system design as well as software generation. Most input materials are in cartographic map format and may be categorized in terms of the range of scales and physical sizes of input maps and the number of maps that need to be digitized. All geographic information can be categorized into three groups: point, line and polygon. Points represent historical sites, buildings, wells and springs. Lines represent topographic contour lines, highways and streams. Polygons represent soil patterns, vegetation patterns and lakes. These data may be delineated by location (point, line or polygon) or by descriptor, such as the name of a soil type, vegetation community or highway classification. A separate group of input materials includes remote sensor imagery such as black and white air photos, infrared or multi-band imagery and radar imagery. If these kinds of data input are used, an extra dimension is added to the complexity of the data bank. This includes the interpretation process, either an automated or manual technique, and the process of correcting imagery distortion caused by sensor equipment.

Input Device Selection

As the format of input material is known, the next step is to design the hardware and software of the input system. Three types of input devices can be grouped:

(1) Manual input system, using a manual digitizer to digitize the point, line and polygon. Also, the descriptors are inserted manually.

(2) Semi-automated input system, using an automated digitizer and either a raster scanner or a flying spot line follower to digitize points, lines and polygons. If the input material is a colored map, the description can be automatically recorded. If delineation and descriptor of data are both shown on the map, the descriptors must be manually inserted.

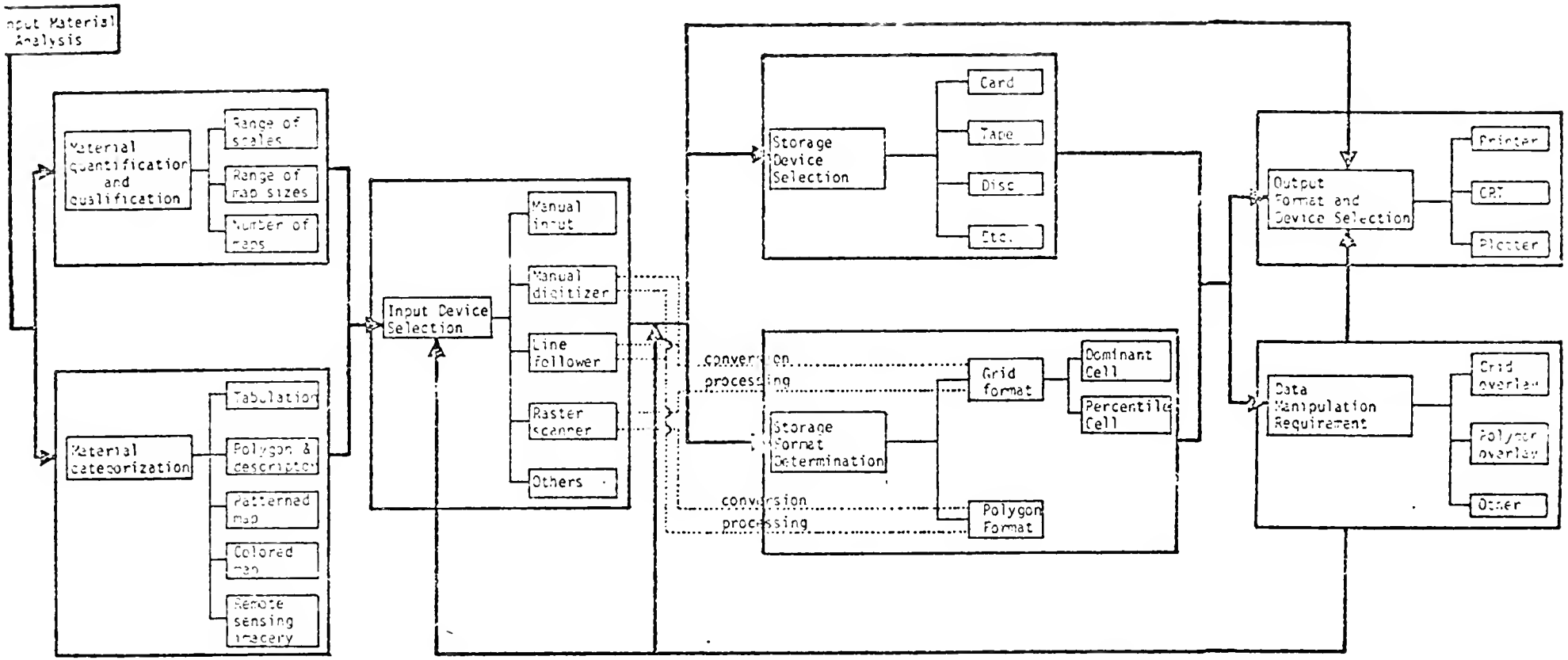

nput Material Analysis
Material Quantification and Qualification
Range of scales
Range of map sizes
Number of maps
Material categorization
Tabulation
Polygon & descriptor
Patterned map
Colored map
Remote sensing imagery
Input Device Selection
Manual input
Manual digitizer
Line follower
Raster scanner
Others
Storage Device Selection
Card
Tape
Disc
Etc.
conversion processing
Storage Format Determination
Grid format
Dominant Cell
Percentile Cell
conversion processing
Polygon Format
Output Format and Device Selection
Printer
CRT
Plotter
Data Manipulation Requirement
Grid overlay
Polygon overlay
Other

Figure VI-1

(A scanner map cannot be directly plotted out through a linear or incremental plotter because the relationship between the points is not indicated (i.e., points are not grouped consecutively to form the line as shown on the original map). Therefore, regrouping or vectorizing the points is essential for plotting purposes.)

(3) Automated input system, using an automated digitizer and also using a pattern recognition technique to automatically record the descriptors. If the descriptors that the data bank has to work with are numerous and varied, an extensive software effort or specialized hardware is required. Also, if the effort of developing an automated process for descriptor recognition cannot be offset by the time saved from using the manual method in accomplishing the same amount of work, then the manual approach is recommended.

A satisfactory input subsystem should meet requirements of efficiency, economy, flexibility, accuracy and reliability. Further discussion of these requirements is as follows:

Efficiency and Economy: The degree of automation relates to the character and quantity of input materials. It is a cost-benefit and efficiency-related decision. It is absurd to be automatic for the sake of automation only. If the manual approach requires thousands of hours of manpower to do the digitizing work, then it is necessary to use the automated approach. The amount of input material, the frequency of use and the time allowed to input all necessary materials are major considerations. Also, manual digitizing will present a greater chance of human errors and inaccuracy which in the end will require more effort in data correction or editing. But, if the quantity of input materials is small and the descriptors are in a very complicated pattern, then it is better to use a manual digitizer.

Flexibility: The more varieties of input materials that can be processed by the system, the higher the flexibility. This flexibility can be achieved either by a manual or an automated digitizer. For an automated digitizer, higher flexibility usually requires a higher level of system sophistication.

Accuracy and Reliability: If the input material is a map, then the inherent accuracy of this map is beyond the control of the data bank. This inherent accuracy is a factor to be considered due to its influence on the output accuracy. The accuracy of a map results from the accuracy of the projection method, the resolution of the hardware that interprets the original material (such as black and white and infrared air photography), the accuracy of map compiling and drafting, either manually or mechanically, and the stability of the medium on which the map is drawn and printed.

If the input material is from remote sensor imagery, the same factors used for maps have to be considered, unless the input system is directly connected with the

remote sensor with an auxiliary system capable of automated data interpretation. If the input system is using a manual digitizer, possible human error should be considered and may require incorporation of an editing process.

The reliability of input hardware, either a manual or an automatic digitizer, relates to its accuracy (or overall accuracy), resolution, repeatability, linearity, orthogonality, scan curvature and stability.

Format Determination

Data storage relates to file format determination, coordinates system determination, storage format determination, and storage device selection. Further discussion of these four items is presented as follows:

File Format Determination: The file format is closely tied to the efficiency of the entire system. It not only saves data storage space and enhances the random accessibility of data retrieval, it minimizes the time required for data manipulation. There are two means of constructing a data file: one is by using one data file per data variable for a unit area with a predetermined size or the entire data bank region, and the second is by using one data file per unit area for all or multivariables.

Coordinates System Determination: When a data file for the entire study region exceeds a certain size, it is economical to divide the file into small sections or sub-files. This will greatly benefit the data output or retrieval subsystem, because when a small area is to be retrieved from a large file, it is necessary to search through the entire file, thus consuming a great deal of time. If the entire file is divided into small sections, then only sections that are cut through by the boundary lines of the retrieved area and the sections within the boundary lines are needed for file searching. To divide the regional file into small sections, one can use either arbitrary grid systems or geological survey coordinate systems. The factors that have to be considered are input device capability (i.e., the size of input material as limited by input device), required input efficiency, random accessibility of stored data (i.e., the nature of data retrieval in order to achieve efficiency), and data manipulation technique used.

Storage Format Determination: The data storage format for an input system is rather simple. It takes the input digital format as its storage format. The retrieval and manipulation systems, however, place many constraints on the format determination. There are two major types of storage format: grid format and polygon format.

A grid format presents the land use and resources data by uniform modular cells. These modular cells can be squares or parallelograms or any other uniform shape such as hexagons and octagons, if necessary. However, the square shaped cell is used most commonly. The data within a modular cell can be presented either in

percentages, which is termed "percentile cell format", or represented by the dominant datum only, which is termed "dominant cell format".

According to the cell size, the grid system can be represented by either regular cell size (i.e., macro-cell) or micro-cell size. The difference between the two sizes is based upon the scale and the actual ground size represented by each cell. The dividing standard is rather arbitrary, but the micro-cell is defined as that cell size smaller than or equal to 1/2500 square inch. (This size is related to the size and scale of the input material.) Any larger amount is a regular cell. For example, if input material with a scale of one inch equal to one mile is used, a cell size smaller than or equal to 0.256 acres is called a micro-cell.

In general, micro-cells of a regional and statewide data bank will have to utilize an automated data input machine because a manual input method would be too time-consuming and costly.

A polygon format represents a closed area or plane bound by line segments. A line segment is a line defined by intersection points (i.e., the beginning and end points of this line segment) or a closed circle.

Selection of storage format depends a great deal on the requirements of data manipulation, although input methods used may create an extra burden in reaching the desired storage format. For example, if polygon format is desired, then data input from a raster scanner which is in run-length coding format must be vectorized in order to be stored in the polygon format. On the other hand, if grid format is desired, data input from a manual digitizer or line follower which is in a linear, incremental or polygon format must be converted into a grid format before going into the storage device.

In polygon format, lines are defined by points or vectors; areas are defined by lines. The denser the digitized points or vectors, the closer this line approaches its original configuration. The accuracy of the data builds at the expense of the storage space available.

The grid system is prevailingly used in computer mapping due to its ready availability. The early grid system was developed under the limitations of the hardware system because most people have easy access to a computer line printer while having very limited access to a manual digitizer and plotter. Converting a geo-information system into a grid system is risky because a grid system is unnatural to the geo-information characteristics. It may also distort the information furnished by geo-information systems to a degree, depending upon the cell size of the grid system when compared with the scale of the geo-information system. Grid systems have their own advantages, but it is extremely important to conduct a reliability analysis prior to using the system in order to determine the size of the grid cell and to determine whether or not the grid system is compatible with the study intent.

Polygon storage format may be compared to grid storage format as both formats relate to data retrieval. Retrieval criteria consist of random accessibility, flexibility and compatibility. Random accessibility requires data output of any arbitrary geographic boundary area desired. This involves file separation and file mergence. In order to separate a geographic area from an existing polygon format data file, it is necessary to read in the X-Y coordinates of the lines forming the area and search out the maximum and minimum X-Y coordinates of each polygon in the file to determine whether it should be included, and if so, check all line segments to determine which ones fall within the desired area. The mergence of two areas or files involves an even more complex series of steps to insure that all border-line segments are properly identified and matched.

In order to separate a geographic area from an existing grid format data file, a rather simple process can be used to eliminate all cells outside of boundary lines. Therefore, assuming that the data files have the same complexity and can provide a similar level of accuracy, from the viewpoint of file separation, the grid format will provide higher efficiency than the polygon format. Mergence of the data file of the grid format involves only rearrangement of coordinates of certain cells, a rather simple task of mathematic addition and subtraction. Therefore, from the viewpoint of data file mergence, the grid format is more efficient than the polygon format.

Higher flexibility of data retrieval demands a capability of arbitrary output format. Data stored in a polygon format have the greatest accuracy (i.e., the original inherent accuracy that can be provided by the input device) and the greatest flexibility because these data can be plotted out at any desired scale. Whether the plot-out is an enlargement or reduction in scale, the accuracy of the original data file is preserved (although enlargement will not enhance the accuracy of the original data file). The data can also be converted to the grid system with any reasonable and desirable cell size.

If data were stored in a regular cell size grid system, these data can only be aggregated upward toward a more crude level rather than disaggregated downward toward a finer level. In this grid system, aggregating upward without losing control of reliability can be conducted in only one fashion; that is, using the width or length of the original cell as the interval unit and aggregating in an integral interval. In each cell, whether it is a percentile cell or a dominant cell, the data are not described by location-related coding. Therefore, no method exists that can break the individual cell without losing control of reliabili Disaggregated downward, the data will more likely lose their original reliability or accuracy.

Because the accuracy of the dominant type, micro-cell size grid system is similar to that of the polygon system (i.e., based upon the inherent accuracy of the input material minus the resolution, e.g., 1/100" and 1/400", of an input device such as the raster scanner), this grid system will have flexibility of arbitrary output format similar to the polygon system if the square of the scan resolution is used as the cell size. The least accurate is the percentile type, regular size grid system because of its relatively large cell size and lack of location specifications within each cell.

Data storage compatibility between two data bank systems or between different data sets within the same data bank depends upon the coordinates system and scale used. For grid systems, it also depends upon the size of the cell. Data compatibility is directly affected by the data input system and data storage format. Different data sets, either from different data banks or the same data bank and with the same coordinates system and scale, are compatible. Through a software effort, one coordinates system or scale can be converted to another.

Data stored in a polygon or micro-cell format have higher compatibility than data stored in a regular cell size grid system because this grid system has constraints due to cell size, as well as differences in coordinates system and scale. If data sets use different coordinates systems, even though they have the same cell size, they are incompatible.

Usually no location specifications are coded within a percentile cell format. Therefore, one cell system cannot be converted to other coordinates systems without losing data reliability. The degree of reliability loss depends upon the cell size and the complexity of data. The smaller the cell size and the less complex the data arrangement within each cell, upon conversion into another coordinates system, the less reliability is lost.

As related to data manipulation criteria of reliability, accuracy and efficiency, the micro-cell grid system offers the greatest advantages. The polygon system offers reliability and accuracy, but is rather inefficient.

Storage Device Selection

Many data storage devices such as cards, tapes, drums and discs are available. For a large bulk of data, cards are not recommended as large quantities are needed, thereby presenting a handling problem. Cards also lack endurance. Tape has the benefit of storing large amounts of data on a relatively small magnetic tape, but it may lack random accessibility. A drum or disc storage device offers long-lasting durability, random accessibility, and relatively small physical dimensions.

Output Format and Device Selection

Because the input and storage systems have already been built into the required output format (either polygon or grid format), the output is only a matter of calling the storage data. The important function of the retrieval system is the establishment of random accessibility and optional scaling.

There are three major output devices available: line printer, matrix plotter, and linear or incremental plotter, which can be either a drum plotter or a flat-bed plotter. The first two devices are usually used for grid format output. The third device is usually used for polygon format output, but can be used for grid format output if necessary.

Data Manipulation Requirements

Data manipulation can be divided into two categories: (1) the manipulation of a grid system which includes percentile cell and dominant cell subsystems; and (2) the manipulation of a polygon system. Under each of these two categories are two subcategories. One is to generate a new data set from a known data set that is already stored in the data bank. Examples are generating a slope and aspects analysis map from topographic data, or generating a construction compatibility map from a soils type map. The second is to merge two different data sets. This is known as the overlay (compositing) technique, and it relates to different mathematical evaluation or combination methods. The following comparison between the polygon overlay system and the grid overlay system is based upon the criteria of reliability, accuracy and efficiency.

The polygon overlay system, offering an original delineation of data type, has a higher rate of accuracy and reliability than the regular cell size grid system. Again, this is because the data in each cell of the grid system are not location specified. Because the micro-cell size grid system can provide accuracy similar to the polygon system, these two systems have a similar level of reliability. In a situation where a regular size grid system must be used for the overlay technique, it is necessary to conduct a reliability study to determine the cell size. Cell size determination depends upon the accuracy level of the original data, the configuration complexity of each data set, and the nature of the study. If the accuracy of the input map is about $\pm$ 500' when compared with the ground truth, it is of no value to use a cell size smaller than 500' x 500' due to the possibility of the entire cell carrying completely false information. On issues related to the configuration complexity of the data set, it is empirically recommended that no more than three data types should be contained within one cell. Concerning the nature of the study (i.e., the study objectives), a fine level decision-making study should use either a dominant type micro-cell size grid system or a polygon system. The scale selection is also essential.

In order to use the overlay technique of superimposing one polygon format map on top of another, a complex series of steps are needed to check all points of polygons which overlap in order to determine the exact configuration of new polygons created by the overlay process. The superimposing of two grid format maps is a rather simple mathematic addition as long as the grid systems of two maps are compatible with each other.

B. Discussion of Computer Systems and Programs

Several data handling systems have been examined for potential application to resource planning activities in Montana. Before discussing these systems, an important comment must be made. There are many data manipulation techniques which can be used to achieve approximately the same study results. Also, there are many types of statistical calculations and computer programming variations which will provide supplementary planning information that is very helpful to decision-makers. These types of software generally can be written or acquired at a relatively minimal cost. However, all types of data manipulation must be performed within the context of some overall organizational methodology. "Methodology" may be defined as the entire planning process and succession of activities

required to evaluate some problem or proposal and reach a decision. Methodology must be based upon existing state policy and legal requirements which delineate the issues and types of information to be considered in any specific type of proposal. These topics are discussed in the criteria section of this report. Data manipulation and analyses occur near the end of the evaluation process, but it is essential to note that these techniques will not provide an "answer" to a given problem. At best, data manipulation will reveal the choices which exist if the relative importance of the various data elements involved in a study are defined.

GMAPS

The generalized map analysis planning system (GMAPS) was developed at the Colorado School of Mines and features a composite computer mapping capability (Turner 1976, p. 15). The GMAPS program is operated from small teletype terminals which are connected to a DEC System-10 computer at the School of Mines. A very attractive feature of the system is its accessibility to non-technical users. The system is operated through a program which displays a series of questions on the terminal screen. The user's responses command the operations to be performed. These commands are listed in the following table.

Table VI-1

Available GMAPS Transactions

Command	Type	Transactions Purpose
Help	S	Gives GMAPS instructions.
Catalog	S	Lists the areas and factors in the catalog.
Area	S	Changes the current area.
Assign	C	Duplicates a file and assigns a new name.
Mask	C	Masks specified areas out of a file.
New Data	I	Reads and checks new data.
Value	C	Assigns numeric values to an alphameric file.
Delete	S	Deletes areas and factors.
Combine	C	Arithmetically or logically combines factors.

Table VI-1 Cont'd.

Print	O	Prints a symbolic map.
Gray	O	Prints a gray-tone map.
Statistics	O	Prints statistics for a file.
End	S	Exit from GMAPS

I = input transactions which allow the entry of new source maps to the analysis.
O = output transactions which produce all the map and statistical displays.
C = create transactions which allow for the creation of new map forms from existing maps.
S = system transactions which involve "housekeeping" tasks needed during the operations of GMAPS. (Turner 1976)

Further description of the GMAPS system components is presented below.

GMAPS accepts map input through the use of manually coded map sectors. Each sector is a block of 120 by 120 cells; each cell contains a single data element or character. The data are coded in symbolic format (numbers or letters) on a sector form sheet or "P-card". It should be noted that only the points of change in the data, which are scanned from left to right, need be recorded. The number of acres per cell is flexible and depends primarily upon selection of a suitable scale of resolution for the problem being addressed (Turner 1976a).

Data are stored as a sequence of matrices, each equivalent to one sector. The format is cellular.

Data are output through a line printer which can produce gray-tone maps or symbolic maps and histograms which delineate the percent of map area assigned to each map variable or valuation code. The output maps can be checked and edited for accuracy by overlaying them on the original source map. It should be noted that this method of cellular input can present a stretching problem which results in locational distortion of data.

GMAPS contains a number of significant data manipulation capabilities. As many as ten separately weighted maps can be overlayed and combined to produce a single composite map. Each map is weighted as a whole and all elements included within each map are ranked by numeric codes in a possible range of zero to nine. A logical compositing technique allows two maps to be merged on a cell-by-cell basis so that up to ten pairs of conditions can be checked. The sensitivity of each factor valuation also may be statistically calculated. This reveals the "margin" or valuation for that factor which would be required, when combined with any other factor or factors, to produce alternative study results (i.e., a

different preferred site or route designation). Various study areas may be selected for analysis from within a larger mapped region.

GCARS

The generalized computer aided route selection (GCARS) system was also developed by Turner in 1968 and may be considered a partnership operation of GMAPS. GCARS is an example of linear programming which applies minimum path analysis techniques to numerical cost models to generate a series of ranked alternative routes or corridors. "Cost" in this context is a measure of desirability which combines directness of route and least cost of all factors considered. The numerical cost models represent various objectives. They are stored as matrices but may be conceptualized as three dimensional surfaces (see Figure VI-2 below) with the "valleys" representing least cost.

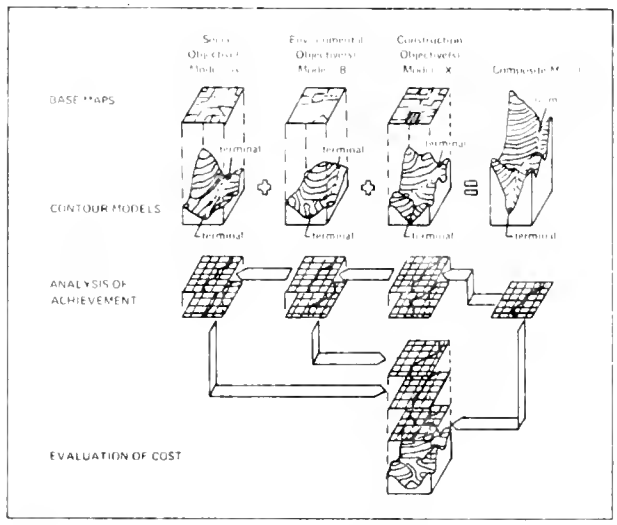


Figure VI-2– Basic concept of GCARS system (adapted from Turner 1968).

The computer analysis proceeds cell by cell, choosing the path of least cost. Second, third, and successively less desirable alternatives are discovered by raising the "cost" values of the cells or links of the preferred route so these won't be selected in the same sequence again. The composite model is derived through use of GMAPS compositing routines.

GCARS produces maps of the routes or superimposes the routes on appropriate gray-tone maps. Statistical summaries are also produced which provide the user with various numerical analysis of the length and cost of each route.

Discussion of GMAPS/GCARS

Ecological Consultants, Inc.: The GMAPS/GCARS system presently is programmed through centralized computers at the Colorado School of Mines and is available through a consulting firm called Ecological Consultants, Inc. (ECI). ECI is primarily interested in providing the GMAPS/GCARS methodology, rather than simply providing software capabilities. A computer terminal and training in use of the terminal and the GMAPS/GCARS analysis procedure are supplied to clients. If a project is contracted, ECI takes responsibility for converting all source data into sectors and placing them in the system.

The arrangement involved in utilizing GMAPS/GCARS through ECI is not applicable to Montana's situation. As shall be discussed later, the State of Montana already possesses computer hardware and software which can perform functions similar to those provided by GMAPS. Therefore, advantages of purchasing ECI's services, as well as a terminal connected to the Colorado School of Mines computer, appear negligible.

Los Alamos Scientific Laboratory (LASL): The GMAPS program could also be available to the State of Montana through the Los Alamos Scientific Laboratory at Los Alamos, New Mexico. The Federal Energy Research and Development Administration sponsors the Regional Energy Assessment Program (REAP), which is partially administered through a special LASL research group known as Q-10. This program concentrates upon "resource utilization problems and opportunities likely to arise in the course of energy development activities in the Mountain States . . . of Idaho, Montana, Wyoming, Nevada, Utah, Colorado, Arizona and New Mexico". The specific goals of the program are listed below:

(1) To provide the basis for the development of a rational energy policy for the utilization of resources in a manner to minimize detrimental effects.

(2) To provide long-term projections of energy, water, and mineral production and utilization for the region.

(3) To provide a means for the evaluation of the impact of new technology so that these factors can be incorporated into both regional and research planning.

(4) To evaluate the importance of legal and institutional constraints on regional growth, energy consumption and production (REAP 1976, p. 1).

Under the auspices of this program, LASL is interested in providing assistance to the states listed above.

LASL possesses highly sophisticated computer hardware which the Q-10 Research Group has utilized to apply advanced research in spatial data handling techniques. LASL utilizes the basic GMAPS program but has made several improvements to increase efficiency, increase display capabilities and extend editing capabilities.

Any of the eight Mountain States may undertake a jointly funded spatial data research project with LASL. Such a project must satisfy REAP's energy planning criteria before LASL's involvement could be justified, but it appears that many aspects of a statewide energy facility siting study would provide this justification. Other considerations are as follows (Vogel 1976):

(1) LASL has an in-house restriction on hiring new staff; therefore, the availability of existing staff to work on new projects is a major constraint.

(2) LASL cannot "sell" its computer capabilities; any projects accepted must involve data analysis and application of methodology.

(3) In a joint project, the state would be responsible for all input data and for preparing this data in the manually coded cellular format required by GMAPS. The state would also be responsible for assigning weights to the various data elements included in the study.

(4) LASL would process the data and produce either gray-tone or colored maps which it would then composite and otherwise analyze to produce the study results.

The possibility of negotiating a joint study between the State of Montana and LASL remains an option for the future which could be tapped for many types of statewide or area-specific resource and energy-related studies. LASL could apply many sophisticated computer hardware capabilities to such a study which would probably be economically unfeasible for a state to duplicate by itself. This specifically refers to display capabilities, techniques for accurate analysis of remote sensing data, and other advanced research techniques. However, the advantages provided by these capabilities may not substantially affect study results. The potential advantage of shared funding would have to be evaluated in terms of the specific monetary costs involved, the study objectives, and the comprehensive costs and benefits for each partner for a specific project.

CMS II

A cellular composite mapping program known as CMS II is available from the Federation of Rocky Mountain States (FRMS) and is presently being utilized by the Montana State Department of Community Affairs (DCA). This program contains many data manipulation capabilities, but also presents some potential problems for users. The original CMS I program was written in COBOL computer language and was developed for use in UNIVAC and CDC computers. In 1974, FRMS secured a grant to redevelop CMS I for use in more widely distributed IBM computers with ANS-COBOL compilers (FRMS 1976a, p. 2). The new program is called CMS II. It can be adapted to many types of input and output devices and it will accept various types of input data as indicated in Figure VI-3. The input may be manually coded or automatically digitized. Cellular storage format is required.

Data manipulation capabilities include compositing, cell aggregation, various statistical and logical computations, and a polygon to cell conversion program. However, the conversion program is not operational at this time. A detailed description of CMS II is provided in the users manual available from FRMS and available for inspection at DCA.

Through the computer system operated by DCA, Montana was the first state in the Federation to utilize CMS II. The primary problem DCA and others have had with CMS II is its inefficiency in terms of the length of time the hardware must take to perform the program operations. This inefficiency is directly related to CMS II's COBOL program language. Therefore, other programs with similar capabilities written in more inherently efficient languages may be considered preferable in terms of long-run cost.

Department of Community Affairs

The Research and Information Systems Division of DCA is a data collection unit within Montana State Government which deals with many types of information (i.e., demographic, social, economic, natural resource, etc.). This division has the computerized capability to store and analyze spatial data. DCA has not always been oriented toward the collection or handling of natural resource data, but it has been acquiring increasing amounts of this type of information in response to various user contracts and data analysis projects over the past few years. As a result, programs such as CMS II have been acquired. Additionally, DCA was designated Montana's land use planning agency by executive order of the Governor in July 1975 with attendant responsibility to develop and maintain a centralized information system containing appropriate data. DCA depends upon outside consultants for semi-automatic digitization of source data. The data is stored in both polygon and regular cellular format. It is felt that both formats serve necessary functions. However, a reliable conversion program for transferring data between the two formats is essential.

Versatile Inputs and Outputs

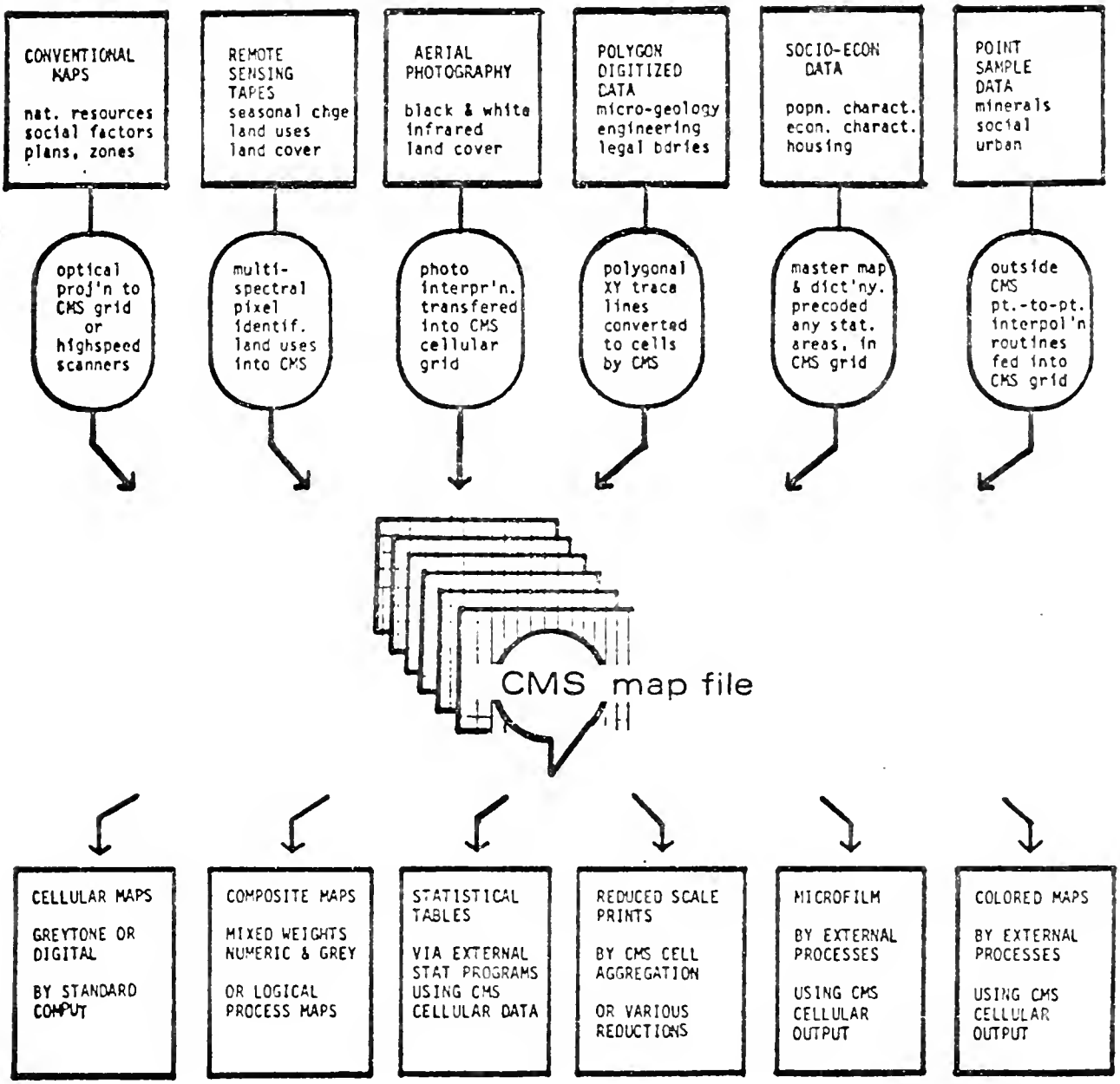


Figure VI-3

Federation of Rocky Mountain States, 1976a.

DCA has been involved in a project with the Department of Revenue for the past year and a half to digitize the corners of all the section boundaries in the State of Montana. When this project is complete, it will significantly increase the accuracy of the DCA grid system.

DCA utilizes a drum plotter for production of polygon maps and a line printer to produce its cellular map output. These hardware devices are located at the Department of Highways. Output forms include gray-tone and symbolic maps and histograms.

The DCA system possesses map compositing and analysis capability as well as various types of logical and statistical analyses capabilities. Additionally, the system has programs for cell aggregation, file separation and file mergence for any combination of data factors.

Environmental Resources Geo-Information System (ERGIS)

The data handling system presently owned by the Montana Department of Administration but principally used by the Energy Planning Division (EPD) of the Montana Department of Natural Resources and Conservation has been described in the 1975 publication referenced and quoted earlier in this report.

ERGIS' use as a data bank would necessarily involve very large amounts of input data, frequent use, and relatively short amounts of time to process input materials to required specifications. ERGIS' function as a tool to be used in decision-making, with the accompanying demand on its data manipulation capabilities, has not been considered a separate or additional load factor. However, this function clearly places demands on the system (beyond its data storage functions) which strengthen the conclusion that automatic digitization is essential (DNRC 1975, p. 71). Thus, a raster scanner was selected for the system input device. This imposed the input format requirements identified in the discussion on input device selection (see Section IV-A of this report) (DNRC 1975, p. 43).

A longitude-latitude coordinate system was selected for ERGIS. This coordinate system theoretically does not present compatibility barriers to potential interaction with other systems, but it has not yet been utilized or applied to a specific project.

Data is digitized, stored and manipulated in a dominant type micro-cell grid format. This format appears to combine the advantages of accuracy, flexibility, and compatibility with other systems provided by polygon storage, with the greater data manipulation efficiency (i.e., compositing) and random accessibility provided by cellular storage.

ERGIS is not restricted to any particular output device. A line printer and matrix plotter are presently utilized.

ERGIS' data manipulation capabilities include: file separation and file mergence to provide random accessibility of data (this allows for selection of new study areas and other types of data configurations which may vary from the initial input arrangement); vectorization of scanned data to return the data to its original configuration for display purposes; conversion of run-length codes into polygon format; aggregation of cells which can be scaled to a size equivalent to the smallest cells used in regular grid systems; line thinning to reduce data boundary lines to one-cell width; and calculation of acreages.

ERGIS has an efficient compositing program which has been successfully substituted in some of DCA's work for the more inefficient CMS II program. ERGIS does not possess an automatic corridor selection technique. Routes or corridors are traced manually through analysis of the shaded areas shown on composite maps.

C. Summary Discussion

The data systems described above require further discussion in terms of their relationship to the management of resource data in Montana. The first portion of this subsection deals with system-related concerns.

The advantages and disadvantages of manual and automatic or semi-automatic system input devices have been discussed in Subsection IV-A. The volume and complexity of data to be handled with efficiency, flexibility and reliability are the basic factors to be considered in evaluating digitization techniques. It was intended that the input material for ERGIS' raster scanner should "be limited to descriptor maps with different colored dots representing different descriptors and colored maps . . . to simplify input material categorization" (DNRC 1975, p. 72). However, ERGIS' capability to handle color has not been utilized fully because of difficulties in scanner recognition of certain color variations. Therefore, manually drafted "black and white maps" of publication quality with separate overlays for descriptors have been used for most of ERGIS' input. Thus far, this has not presented a hardship in that most of the map information put into ERGIS has also been published by EPD and therefore has required manual drafting anyway. However, depending on the complexity and volume of data involved, it appears valid to raise the question of whether the manhours required for manual preparation on input for the scanner fully offset the manhours which would be required for manual or semi-manual digitization. Access to a cartographic staff is required by the present situation. The scanner can record a finer degree of detail than may be manually feasible, but it appears that the potential for human error has a

nearly equal chance of affecting some portion of either process. Most sources consulted during this study have noted that manual and semi-manual digitization techniques have not economically inhibited commercially competitive firms nor have such techniques adversely affected the management of relatively large amounts of data in short periods of time.

It should be noted that ERGIS was not fully applied to a major project before publication of the Anaconda-Hamilton transmission line study by EPD earlier this year. Thus, there has not been an adequate basis for comparison of ERGIS with alternative systems.

This discussion is not intended to prove either type of digitization superior, but it does touch on issues affecting future data handling choices for Montana. In the past, DCA's digitization work has been contracted to out-of-state consulting firms using semi-automatic techniques. Examples also exist of state agencies and other users pursuing cost-inefficient digitization arrangements on their own, perhaps due to unawareness of the options open to them through DCA or EPD or perhaps because these options have involved the complications noted above (i.e., reliance on out-of-state contractors or extensive manual input preparation).

Compatibility between systems is another major factor affecting future data management within Montana, as well as future data exchanges within the western region and with federal information sources. Compatibility may be analyzed in several ways, including comparisons of coordinate systems, coding mechanisms, and storage formats. For example, several systems discussed in this report utilize the CMS II program or are compatible with it because of similar coding (i.e., use of P-cards) which is cellular based. Thus, GMAPS, as it is utilized by ECI and LASL, and CMS II as utilized by ECI, LASL and DCA are compatible and data programmed through these systems could probably be transferred or exchanged with a minimum of programming adjustments.

Likewise, a number of programs have been or are being developed which address the problem of converting data from cellular format to polygon format or vice versa. It should be noted that these are two separate operations posing separate technical problems; they are not merely the reverse of one another. ERGIS has a program for conversion of micro-cell data to polygons which is presently operational, although all of ERGIS' data is in run-length coding format. A portion of the CMS II package used by DCA was supposed to provide conversion from polygons to cells, but this program has not worked properly and some specific directive or assignment of personnel to work on the problem would be needed to make it operational. Also, ERGIS' micro-cells are essentially equivalent to overlaying a very small grid on a very large-scale data base. The micro-cells are still cellular in format and their properties actually could be duplicated by a more conventional cellular system through the process just noted if there was a rationale for incurring the cost.

The principal ERGIS characteristic which is not featured in the other systems and which would have to be considered in any transfer of data between these systems is the run-length coding format. The run-length code is presently a part of the software which operates the scanner and all of the scanner's output is in this format. The means to trade ERGIS data with data programmed through CMS II presently exists. However, it involves the use of two programs: One to convert CMS II information and one to convert ERGIS data to an intermediate form which both systems can accept. This intermediate form is from the CMS II package and it would output information in CMS II's coding format. ERGIS information (within its own code) is more compact and therefore cheaper to store. If it were necessary or desirable to transfer ERGIS data to any other cellular system, the ERGIS files would probably have to be decoded.

The most important compatibility problem is not related to system design, since programs exist or can be written to overcome most of the technical problems of data exchange. Management of these systems is a far more formidable barrier to the coordination of Montana's existing computer hardware to meet user information needs (the data bank function) as well as decision-making requirements (data manipulation and analysis). The most significant aspect of this problem has been the lack of close coordination and communication between the agencies which manage the systems. This has been evidenced through a general lack of awareness of one another's activities as well as unfamiliarity with the contents of one another's data files or the specific potential for compatibility between the systems.

A closely related issue concerns the fact that ERGIS is presently not a data bank, even though it has the system capability to be utilized as such. At the present time, ERGIS contains only data used in facility siting-related studies performed by EPD. The bulk of this information is not source data which could automatically be applied to other uses. Rather, it is manipulated data which has been input in terms of its relation to various electric transmission line impacts. Although the system has been oriented toward its potential use in making siting decisions, this does not imply that EPD has no need or inclination to use the system as a data bank, especially with regard to processing future siting studies. However, development of this function has not yet occurred. Also, the ERGIS system generally has not been used outside of the Energy Planning Division.

This situation may partially be explained by noting that no authorization or funding has been granted to either EPD or ERGIS' present owner, the Department of Administration, to develop the system's full potential. The lack of coordination between ERGIS and the DCA system also may be explained by a similar lack of specific direction as well as a general lack of perception of common goals. Until such official directives and funding are assigned, the coordination effort and the accompanying expense of system development will not be undertaken. The concerns mentioned initially in this section -- lack of user awareness and understanding of the computer services available -- have also been adversely affected by the general lack of coordination of services, especially as they relate to natural resource data and resource planning activities.

It is in the state's best interest to achieve coordination of its existing computer capabilities. State coordination of resource data assembly and storage activities is a complementary objective which is discussed in Section V. A portion of the following recommendations offers a means of dealing with the overall coordination problem.

RECOMMENDATIONS

Criteria Development and Siting Inventory

The Major Facility Siting Act should be amended to require that a special task force be funded and commissioned by the Legislature to develop criteria to be utilized in a statewide siting inventory and to assume oversight responsibility for the inventory effort. The criteria ultimately developed and utilized by the task force should be formally included in the rules and regulations of the Major Facility Siting Act.

This recommendation recognizes the need for comprehensive long-range planning in the siting of energy conversion facilities. Its implementation will provide front-end assistance to both regulatory agencies and to applicants.

A siting inventory must be based upon a series of criteria which identify and categorize the complex information needed to compare and evaluate geographic areas in terms of their relative suitability for energy facility siting. Development of adequate siting criteria will be a major effort in itself which will determine the subsequent quality of the siting inventory. A special consideration of the task force should be the establishment of exclusion and avoidance criteria categories which, respectively, would classify land uses and areas where siting would be absolutely prohibited or permitted only in the absence of reasonable alternatives.

Some types of criteria may require important policy-related decisions if they are to be included in the inventory. These include, but are not limited to, determination of the extent of non-agricultural uses to be allowed in areas of limited surface and ground water supplies; the protection or status to be accorded to agricultural and timbered lands as these areas relate to potential facility siting; and the siting of facilities near urban areas as opposed to siting in remote, sparsely populated regions.

The task force should be authorized to investigate or fund the investigation of topics which will require development of appropriate criteria, but which will require in-depth study before recommendations may be made. These topics include the transboundary effect of siting facilities near interstate or international boundaries; the synergistic effect of siting two or more types of energy generation or conversion facilities in close spatial proximity; and the indirect impacts of siting created by increased economic activity and development in a site area.

The task force should include individuals with established expertise in both natural and cultural environmental disciplines which will affect or be affected by siting decisions and should also include representatives from a wide range of interest groups concerned with siting decisions, including, at least, the public at large, local governments, industry, utilities and agriculture.

The task force should be assisted and advised by all governmental agencies having expertise or regulatory responsibilities affected by siting decisions. However, future decisions by the Department of Natural Resources and Conservation and other land use-related decisions by other agencies should not be compromised or influenced by these agencies' roles in criteria development. Potential future conflicts of interest of this type will be avoided if a task force independent of these agencies is responsible for criteria decisions.

The siting inventory should be directed toward designation of areas within the state that are unsuitable for future siting of energy facilities. The designation of unsuitable areas is preferable to designation of specific suitable sites because the latter option ultimately would require that the state conduct costly site-specific studies without benefit of specific plant design characteristics to justify site selections. Designation of unsuitable areas should be accompanied by development of preferred site selection criteria to guide future applicants' proposed site selection activities.

Data Collection, Storage and Retrieval

One state agency should be designated the resource data assembly and storage unit, charged with the maintenance of resource data files to meet the planning and decision-making needs of other state agencies, county and local governmental units, and the widest possible range of other uses.

A general lack of interagency coordination and the preoccupation of each agency with its own area of responsibility has resulted in fragmentation of responses to land use and resource management problems. These types of problems, by nature, involve many complex, overlapping concerns which it has been impossible to consolidate administratively. Portions of the information needed to solve these problems may potentially be applied in many different contexts by different agencies, but nonstandardization of resource information has hindered coordinated use. The above recommendation would provide a means of correcting this situation.

Implementation of this recommendation will require funding and expansion of appropriate staff within the agency assigned this responsibility. However, existing and potential users of resource data must have major input into the design of a data storage system, selection of data storage categories, designation of data accuracy standards, and other related decisions. Agencies with decision-making responsibilities which require resource data should remain responsible for collecting necessary information, but with the understanding that this data would be stored and utilized in the overall data system.

It should be noted that the site inventory effort will require reliable, standardized statewide information in many data categories. Depending upon scheduling and other decisions, the implementation of that site inventory recommednation and the above data assembly and storage recommendation would be highly complementary.

Resource data is being digitized for use in existing computer systems in the state. These efforts should be strongly encouraged and supported. Also, the digitization of reliable statewide resource information to meet immediate planning needs should be a major objective of the data assembly and storage agency. The computer hardware used for data storage can also be used for data maniuplation and analysis activities, but the management responsibility for each function must be clearly specified and considered equally important.

A committee familiar with both the technical aspects of computer system design and the special requirements of resource data should be assigned the responsibility of evaluating the computer systems in the state and improving resource data handling capabilities.

The existing data processing policy committee could meet this requirement if members with specific understanding of geographic, resource-related data are included.

The two alternatives for data digitization presently existing through the Department of Community Affairs and the Department of Administration appear less than optimal. Improvements may be achieved through better coordination of existing hardware. Also, the purchase of a semi-automatic digitizing device could be considered. However, it would be necessary to compare this expense with the cost of continuing to contract projects to out-of-state firms. The capabilities of the Department of Administration's raster scanner, with its special input requirements and coding format, must also be evaluated before any decisions are made.

With input from potential system users and the data assembly and storage agency, the data processing committee should review the various software capabilities presently available in the state and recommend other capabilities which should be purchased or written in light of future needs for analysis of resource data. Both cellular and polygon storage systems appear to offer distinct advantages which should be maintained, but this will require development of reliable conversion programs.

Tests and comparisons between systems and data handling costs may be required in order to formulate optimal recommendations.

Effort must also be devoted to develop more effective presentation of Montana's computer capabilities to potential users.

Public Involvement

The Major Facility Siting Act should be amended to adopt broad spectrum public participation as a principle of operation.

The forms of participation should not be limited to public hearings, but should also include advisory committees to work closely with the state siting agency in the power plant siting and transmission line routing processes. This policy also would apply to the activities of the siting inventory task force.

Short-Term Planning

The siting act should be amended to require the filing of a notice of intent to file an application for a certificate of environmental compatibility and public need for a major energy facility at least twelve months prior to the actual filing of an application. This notice must disclose the specific site location being considered for the proposed facility.

A specific enforcement clause should be added to the siting act which would impose severe penalties upon any person who knowingly submits false or misleading information in the ten-year plan.

These two provisions would serve short-term site planning needs prior to completion of the siting inventory; however, they should not be viewed solely in this context. The notice of intent would provide greater opportunity for public review and input into site location decisions and would allow the state and the applicant to confer on the suitability of a given site and identify problems as well as areas of agreement prior to the actual application process. This would streamline the process and eliminate major delays following application. The enforcement clause is designed to insure compliance with the intent of the ten-year utility long-range plans presently required by the siting act. These plans are the state's principal source of information regarding future plans for construction of energy facilities and their proposed general locations.

Additionally, the state should consider developing a specific methodology which utilities would be required to follow in formulating the energy demand forecasts required in the long-range plans. This would allow more efficient state review and analysis of the forecasts while the future level of state involvement in projecting energy demand is being determined.

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